VOL. 108 • 2813 • PAGES 573-614

November 26, 1948

Science

Proceedings Issue: AAAS Centennial

Washington, D. C., September 13-17, 1948

CONTENTS

The AAAS and Organized American Science: *F. R. Moulton* 573

The Membership Campaign: *John M. Hutzel* 578

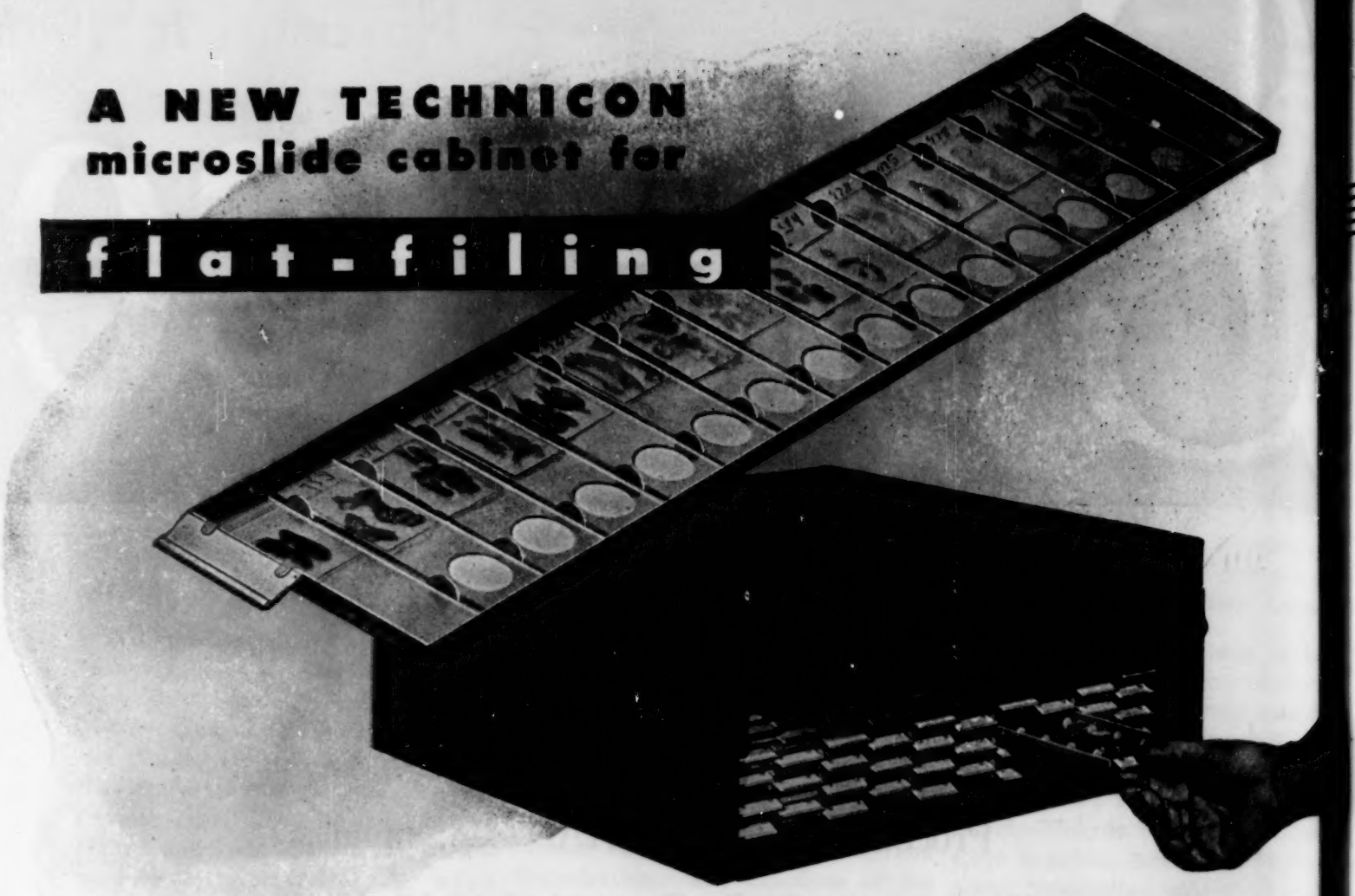
Abstracts of Symposium Papers and Evening Lectures 579

Comments and Communications 606

News and Notes 610

Greetings and Resolutions 614

A NEW TECHNICON microslide cabinet for flat-filing



As slides are freshly completed they are put at once into these compartmented flat-filing trays. The slides are then handled, filed, and dried in the same tray: they need never be removed except for microscopic examination. Slides do not contact each other, drying is speedier, cover glasses stay put.

Complete visibility. Each specimen, with its identification data, stands out boldly against the neutral gray background of the tray floor . . . a great convenience in the storage, distribution, and return-checking of reference collections in classroom work.

Large capacity. Fifty drawers in each cabinet, with sixteen or thirty-two slides to the drawer. All-steel construction throughout, like all other Technicon "LAB-AID" microslide files.

Fresh slides go directly from laboratory-to-microscopist-to-file, always in the same light-weight metal tray. Cabinet units are small enough to fit easily on desk, and can be stacked with existing "LAB-AID" vertical slide-files.

TECHNICON *Lab-aid* **flat-filing microslide cabinet**

THE TECHNICON COMPANY
215 East 149th St., New York 51, N. Y.

Send me particulars of "LAB-AID" flat-filing cabinets.

Name_____

Address_____

City_____ State_____

DeRobertis, Nowinski and Saez on

GENERAL CYTOLOGY

THIS new book has aroused an unusual amount of interest because of the widely-publicized work (microphotographic records of the path of the poliomyelitis virus along nerve fibers) being done by Dr. DeRobertis at the Massachusetts Institute of Technology.

As might be expected from the above, GENERAL CYTOLOGY contains a great number of electron micrographs and they are among the finest such pictures ever published. Other forms of microscopy and x-ray diffraction are also represented, and their methods fully described.

The text matter itself is complete, detailed, and thoroughly up-to-date in every way. It goes beyond static methods of fixation and staining to explore the "ultrastructure" of the cell, and it makes use of physical, chemical and biochemical means to interpret the nature of intracellular processes.

The material basis of heredity is taken up and sex determination discussed. Cell respiration and metabolism are well covered.

By E. D. P. DEROBERTIS, M.D., Department of Biology, Massachusetts Institute of Technology; W. W. NOWINSKI, Ph.D., Tissue Culture Laboratory, and Department of Neurology and Psychiatry, University of Texas Medical Branch, Galveston; and FRANCISCO A. SAEZ, Ph.D., Institute for the Investigation of Biological Sciences, Montevideo. 345 pages, 6" x 9", with 143 illustrations, some in color. $5.50. *New.*

Published by

W. B. SAUNDERS COMPANY

West Washington Square Philadelphia 5

Science

AAAS EDITORIAL BOARD
(*Terms expire July 31, 1949*)
Arthur Bevan Bentley Glass Malcolm Soule
Edward Condon Everett Walli
George Baitsell, *Editor-in-Chief*
Mildred Atwood Rustigan
Executive Editor of Science
Advertising Representative, F. A. Moulton

Vol. 108 No. 2813 Friday, November 26, 19

Proceedings Issue: AAAS Centennial
Washington, D. C., September 13-17, 1948

CONTENTS

The AAAS and Organized American Science: *F. R. Moulton* 573

Howard A. Meyerhoff—Administrative Secretary: *F. R. M.* 577

The Membership Campaign: *John M. Hutzel* 578

Abstracts of Papers Presented at the AAAS Centennial Celebration 579

Comments and Communications

Adventures in Mailing *Science*; Australian Sod Fly Introduced Into California; If This Be Treason—; Quantitative Estimation of Amino Acids on Paper Chromatograms; Parasites to Aid in the Control of the Sweet Clover Weevil 606

News and Notes 610

Greetings and Resolutions 614

Science, a weekly journal, is published each Friday by the American Association for the Advancement of Science at The Business Press, Incorporated, N. Queen St. and McGovern Ave., Lancaster, Pa. Founded in 1880, it has been since 1900 the official publication of the AAAS. Editorial and Advertising Offices, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Telephone, EXecutive 6060 or 6061. Cable address, SCIMAG, Washington, D. C. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in paragraph 4, Sec. 538, P. L. and R., authorized January 13, 1948.

Articles offered for publication should be sent to the Editor. The AAAS assumes no responsibility for the opinions expressed by contributors. Membership correspondence for the AAAS should be sent to the Administrative Secretary.

Annual subscription, $7.50; single copies, $.25; foreign postage (outside the Pan-American Union), $1.00 extra; Canadian postage, $.50 extra. Remittances and orders for subscription and single copies should be sent to the Circulation Department, AAAS, North Queen Street and McGovern Avenue, Lancaster, Pennsylvania, and 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Claims for missing numbers will not be allowed if received more than 60 days from date of issue. No claims allowed from subscribers in Central Europe, Asia, or the Pacific Islands other than Hawaii or because of failure to notify the Circulation Department of a change of address or because copy is missing from the files.

Change of address. Four weeks notice is required for change of address. This should be sent to *Science*, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. When ordering a change, please furnish an address stencil label from a recent issue. Address changes can be made only if the old as well as the new address is supplied.

The American Association for the Advancement of Science also publishes *The Scientific Monthly.* Subscription rates on request.

The AAAS and Organized American Science

F. R. Moulton, *Administrative Secretary*

FROM SEPTEMBER 13 TO 17, INCLUSIVE, the American Association for the Advancement of Science held a meeting in Washington in celebration of the 100th anniversary of its founding. Very little attention was given, however, to the origin and history of the Association. Emphasis was naturally placed, instead, on the rapidity and diversity of scientific progress, the great contributions science has made to human welfare, and the hopes and fears it arouses for the future of mankind. Those who attended the meeting were thrilled by the glorious vistas science opens before them, and awed by the terrible destruction of which it is capable.

Like everything else, the Association had antecedents out of which it evolved. In the immediately preceding centuries universities and academies of science had been organized in various European countries—universities in Bologna (1156), Oxford (1167), Paris (1200), Cambridge (1284), Vienna (1364), and, in America, Harvard College (1636); an academy of science in Florence (1657), the Royal Society of London (1662), the Paris Academy (1666), the Prussian Academy (1700), the Russian Academy (1725), and the Swedish Academy (1741). The American Philosophical Society had its beginnings in 1743 and received its first charter from the Commonwealth of Pennsylvania in 1780.

The universities and scientific societies, in turn, were inspired by the achievements of their predecessors—by the literature from the Psalms and Homer down to Shakespeare; by the science from Archimedes and Euclid to Galileo, Kepler, and Newton. The Crusades had intermingled the peoples of Europe; the invention of printing had made it relatively easy for them to communicate with one another. The voyages of Columbus and his successors had revealed new continents and encompassed the earth; the telescopes of Galileo, Newton, and Herchel had surveyed the Solar System and reached out toward the stars. At this stage in human progress Europeans of the same race and having generally similar cultures began to explore and occupy this Western World.

After the American colonists had won their political freedom they set up a permanent, united government for the 13 contentious colonies which had previously existed. Then they began to survey the limitless resources of the vast areas under their control. Their attention soon turned to the mineral riches that might be brought to light by geological explorations of this new continent. Between 1823 and 1839, 17 states made provisions for geological surveys within their respective borders. This rapidly increasing interest in geology led to attempts at establishing national geological societies. The first one was incorporated in Connecticut in 1819. This society died in 1826, but its spirit reappeared in another society organized in 1840. Similar interests were aroused in the fields of botany and zoology. In 1836 New York began a natural history survey, and the following year Massachusetts provided for a zoological and botanical survey. Finally, in 1840 a society known as the National Institution for the Promotion of Science was incorporated by an Act of Congress. The opening address of a pretentious meeting of this society, held in Washington in 1844, was delivered by John Tyler, then President of the United States. A former President of the United States and several members of Congress served as chairmen of its various sessions. The society never met again.

Four years later, on September 20, 1848, the Association of American Geologists and Naturalists (organized in 1842) was transformed and expanded, by vote of its members, into the American Association for the Advancement of Science, with an initial membership of 461. In purposes and operations the AAAS followed the general pattern of the British Association for the Advancement of Science, which had been organized in 1831.

In contrast with earlier American scientific societies, the interests of the AAAS extended into all fields of science, and its geographic territory included a continent. It welcomed into membership those who had become famous as scientists and those who were entering on the pleasant pathways of science. The first session of the first meeting, September 20, 1848, was held with democratic simplicity and sincerity, in contrast with the pomp and ceremony of the politically sponsored meeting held only four years earlier. At a "general session" of the meeting Benjamin Peirce, the foremost of American mathematicians at that time, presented a paper, "On the General Principles of Analytical Mechanics." He was followed by the famous Swiss naturalist, Louis Agassiz, who presented a paper entitled "On the Classification of the Animal Kingdom." The pattern of these general sessions, open to all scientists, has been consistently followed as a part of the meetings of the Association for 100 years. These sessions have done much to keep always in the minds of specialists that fundamentally there is only *One World of Science,* a phrase weighted with

deep meaning which was adopted as the theme of the Centennial Celebration held last September.

Diversity in the programs of the Association and opportunities for discussing details of current scientific problems were attained from the beginning by establishing sections for special fields. At the first meeting of the Association there were only two sections, one including, roughly, the physical sciences and the other the biological sciences. From time to time new sections were organized, partly because increasing numbers of papers to be presented made subdividing necessary and partly because it was advantageous to have detailed discussions among specialists. The Association now has 15 sections, together covering largely the fields of the natural and the social sciences.

In the first 30 years (1848–78) after the Association was founded there were few changes in the character of its meetings. In that interval the membership increased from 461 to only 962. The largest number of papers presented at any meeting was 165, in 1874, when there was also the largest registration, 224. During the Civil War, which was fought in this period (1861–65), no meetings were held nor were officers elected. Yet the pleasant memories of 14 earlier meetings led promptly to their resumption after the termination of the war, the first postwar meeting being held in Buffalo in 1866. Although it was a crippled meeting, the Association was again on the march. Despite a severe financial and industrial depression, its membership more than doubled between 1870 and 1880—from 536 to 1,555.

In the second 30 years (1878–1908) after the founding of the Association there were rapid and important changes in organized science in the United States. These developments were due to many causes, the most important of which was an increasing understanding and appreciation of the fundamental scientific achievements in the preceding decades. To realize their importance and influence one has only to recall Dalton's atomic theory (1808), the electromagnetic experiments of Michael Faraday and Joseph Henry (1820, . . .), the revolutionary theories of Lyell (1830, . . .) about the geologic processes that transform the earth's exterior, the thermodynamics of Mayer and Joule (1842, . . .), and the theories of organic evolution of Darwin and Wallace (1855, . . .).

In this second 30 year period the membership of the Association increased from 962 to 6,136. The memberships of its sections increased correspondingly, and as a result of progressive specialization many new scientific societies grew out of them. For example, the American Chemical Society was founded in 1876, the American Institute of Electrical Engineers in 1884, the Botanical Society of America in 1894, the American Physical Society in 1899, the Americ Society of Zoologists in 1902, and the Entomologic Society of America in 1906. Several of these affi ated societies attained such large memberships th it became necessary for them to hold meetings se arately from the Association.

In the first 6 years (1908–14) of the third 3 year period (1908–38) of the Association's existenc its membership increased slowly from 6,136 to 8,32 and its meetings followed earlier patterns. Then, i 1914, World War I suddenly broke out and thre western Europe and North America into confusio until its termination in 1918. A peaceful and pro perous decade followed in which the membership o the Association increased from 11,442, in 1919, t 18,462 in 1929. Then the membership varied litt for nearly a decade of economic depression, bein only 19,059 in 1938.

When World War II blazed forth it was feare that so many scientists would be drawn into full-tim military service that the progress of science would b retarded and that scientific societies would suffer grea losses in membership. Although demands on scientist were far beyond all expectations, specialists fro every field not only responded fully but initiated an carried to completion methods and weapons of at tack and defense of the highest order of importance. They rendered great services, often at sacrifices, no for financial compensation or glory but in obedienc to feelings of responsibility to society. Even thoug many had to allow their memberships in the Asso ciation to elapse while they were in government ser vice, the Association's membership increased steadil throughout the war period—from 22,000 at its be ginning to 28,000 at its close. In the past three year the increase in membership of the Association ha been still more rapid and now exceeds 42,000. Th following table gives the Association's membership, b decades, during the 100 years since its founding:

Year	*Membership*
1848	461
1858	962
1868	686
1878	962
1888	1,964
1898	1,729
1908	6,136
1918	9,000±
1928	16,328
1938	19,059
1948 (Nov. 1)	42,000

Records of achievements in any field are pleasan and somewhat important as a foundation for antici

ating what may be accomplished in the future. Consequently, the history of the Association should serve primarily as a prophecy of its future service to mankind rather than its growth in membership. In one of his many inspired moments Edgar Allen Poe caught the subtle distinction between the lofty spirit and the aggressive mind in his "To the *glory* that was Greece and the *grandeur* that was Rome."

The program of the Centennial Celebration of the Association emphasized the glories of science as well as the grandeur of its technological applications. The theme of the meeting—*One World of Science*—carries no thought of speed or power, no threat of destruction or promise of a paradise. On the contrary, it implies that science is the same everywhere throughout the world, and this implies, in turn, that the universe is orderly. There is no other satisfying foundation for science and philosophy.

Since science is the same throughout the world, there are broad areas of human interests in which all men agree, irrespective of race, religion, or political theories. If there are differences of opinion in limited sectors of scientific beliefs, they can be removed by observations and experiments, as they have been in the theories of the rotation and revolution of the earth and in hundreds of other controversial subjects. Consequently, the easiest approach to achieving international understanding and cooperation is through science and scientists. As Dr. Shapley stated in his presidential address, astronomers throughout the world exchanged information during the whole period of the war. For many years scientists have held international congresses of specialists in various fields. In no other international meetings has there been so much cordial cooperation and so little friction. The Association adopted with pride *One World of Science* as the theme of its 100th anniversary, because it expresses the unique characteristic of science and holds hopes for the future.

The program of the Centenary was not limited to boasting of the scientific achievements of the past and expressing confidence in the future. The relevant factors on which the anticipated future must rest were subjected to critical examination. For example, the mineral resources of the earth were critically explored. Many of those that certainly appear to be exhaustible, as petroleum and coal, were examined. The Town Meeting of the Air program was "What Hope for Man," again an exploration of the factors on which the future of human beings will depend. Another session explored various sources of energy, the most obvious ones beyond the ordinary fuels and waterfalls being direct solar energy and possible atomic energy. In all these discussions there were dark forebodings but hopes that ultimate disaster might be avoided.

As to the possible future existence of man on this earth, the paleontologists and geologists could present relevant facts for consideration. They have convincing evidence of the existence of life on the earth for something like a billion years. Perhaps a million species of plant and animal life have appeared, flourished, evolved, and finally become extinct; others have survived the vicissitudes of the geological ages. Among those that perished completely were many of the great beasts, such as dinosaurs. On the other hand, certain lower forms of animal life have persisted almost without change for several hundred million years.

Is there anything in the abundant biological record that assures man of a long existence, geologically and biologically speaking, on this earth? Man apparently has no great advantages over lower animals except his brains. But his brains have not saved the great civilizations that for several centuries have flourished in various parts of the world and then crumbled. It is sufficient to recall Babylon, Egypt, and Greece among the many examples known to history. But more fundamental are the geological processes that have transformed and are continuing to transform the surface of the earth. For example, there are large petrified trees in abundance in what is now the treeless Southwest, and the central part of the United States has been covered repeatedly by water. No permanent home for human beings is assured in any part of the earth.

Even if the surface conditions of the earth were stable and enduring, the earth itself might be destroyed in the excursions of the sun and its retinue of planets among the billions of suns and nebulae of our galaxy. The sun itself might be torn to fragments and scattered by even a minute fraction of the incomprehensibly great energy stored in its atoms. In fact, there are frequently great explosions on the sun in which enormous volumes of flaming gases are shot out from its surface farther than the distance from the earth to the moon. Even these astounding manifestations of energy are not a billionth of those that are occasionally seen when the light from an exploding star a million or more light-years distant finally enters the telescopes of astronomers.

As is often emphasized in popular magazines and in a few of the addresses delivered at the Centennial meeting of the Association, science promises in many respects a better future for humans—better food and housing, better education, more leisure, more amusements, better health, longer lives, fewer personal responsibilities, higher flying, faster transportation, faster everything, even to transmitting the text of a book of a thousand pages a thousand miles while the sender is smoking a cigarette. Science also promises

better means of defense—more devastating methods of destroying property and more terrible ways of terminating the lives of human beings who are temporarily regarded as enemies. The result appears to be that in the minds of the general public technology is the wonder of the world today, displacing the circus, the magician, and Santa Claus.

The program of the Association's Centenary was a survey of various important fields of science rather than a record of the Association's growth and importance. Although the Centenary was held at a time when university professors were hastening to their laboratories and lecture rooms, 2,734 scientists registered for the meeting. Every one of the United States and 18 foreign countries were represented. The field from which there came the largest registration, 508, was the medical sciences, and chemistry was second with 342. The registrants from the fields of the zoological and botanical sciences numbered 718. The field of every one of the 15 sections of the Association was represented. Of the registrants from foreign countries, 35 were from Canada and 13 from India. The subjects of the programs and the geographical distribution of those who attended them illustrated the theme of the meeting, *One World of Science*—one world in substance and one world in ambitions for the future.

To some extent the Centenary of the Association was a proud review of its contributions to the advancement of American science. At the same time there were deep anxieties among those who had been chosen to direct its established policies and to plan for better ones in a rapidly changing world. The character of the program was quite different from those of its regular annual meetings, as was appropriate. Clearly something can be learned from them, but wider fields should be explored. Perhaps it would be advantageous to set up some high objective to be attained by the Association, in spite of the fact that the distant future cannot be foreseen, as the whole history of science verifies. Perhaps plans for the future of the Association should rest on the philosophies, the great literatures, and the religions (not theologies) which record in general terms the wisdom of the ages distilled from successes and failures, from high hopes and disappointments, from all the traditions and superstitions preserved in folklores.

Such a program would be far beyond the powers of any individual, and must be deferred, therefore, until general plans can be developed, if ever, for carrying out such an important undertaking. Perhaps some idea of what has been of greatest importance in human history can be inferred from the principles and persons held in highest esteem by peoples of various nationalities and cultures.

As an experiment, consider what precept or principle is generally regarded as the highest moral level ever attained by man. The prompt answer is *The Golden Rule,* a few words that lay a universal foundation for all the varied aspects of human relations. Although it came to European and American civilizations through the Christian religion, its essentials are found in all the great religions. There are so many fundamental similarities among the basic dogmas and precepts of all the principal sects and religions that it is difficult to understand why their votaries have waged against one another many of the most devastating wars of history.

There is, of course, a possible explanation of these tragic human struggles. Perhaps they are expressions of fundamental characteristics of our ancient ancestors which enabled them, in the great biological struggle for existence, to become masters of the world. There are other human characteristics, many in common with higher animals, that were necessary for their survival and evolution during the long periods of the geological ages. As an illustration, among all higher animals the mothers, however docile ordinarily, become raging beasts in defense of their young. Apparently the survivals of man and animals have been due to both cooperative and destructive characteristics.

It would be instructive, and perhaps surprising, if one should undertake to formulate goals for civilization, or even for science. Who are the heroes whose examples should be followed? Not Genghis Khan or Alexander the Great. When the 300 Spartans were slain at Thermopylae by the Persians, they left behind them the message: "Go tell the Lacedaemonians that we lie here in obedience to their command." The story of that fidelity to duty has been a bright spot in human history for more than 2,000 years. The spirit of it has been paralleled, earlier and later, by peoples of every race and culture. It is paralleled in all the history of science. Archimedes, Galileo, Kepler, Copernicus, Darwin, and a host of others are examples of those who have placed truth above approval of their contemporaries and who have drunk the hemlock of criticism and persecution. Whatever general plans may sometime be formulated for the advancement of science and civilization, it is certainly in order now to give as much attention in education and current literature to the heroes of science as to the marvels of technology.

In an earlier paragraph it was stated that the general theme of the Association's Centenary means that science is the same throughout the world, irrespective of race, religion, and political theories. It means also that mutual respect, friendship, and international cooperation of human beings can be established and maintained most easily among scientists.

There is another meaning of the theme which is at least as important as those that have been mentioned. It is that the world is its garden, not in the sense that it extends all over this little planet, or that it gives a common meeting ground for scientists, however much they may differ, or that it provides an abundance of necessaries and luxuries; but in a deeper sense that interest in science is a way of living, of being a conscious part of the Universal Order, awed by the wonders of the past and thrilled with the possibilities of the future. It would be difficult to express more clearly and beautifully the elation the scientist feels in the presence of Nature than is found in *The Chambered Nautilus* of Oliver Wendell Holmes:

> Build thee more stately mansions, O my soul,
> As the swift seasons roll!
> Leave thy low-vaulted past!
> Let each new temple, nobler than the last,
> Shut thee from heaven with a dome more vast, ...

Interest in science is an expression of aesthetic appreciation, not only by professional scientists but also by hundreds of thousands, and possibly millions, of amateurs from nearly every walk of life. Every city and town has its amateur science clubs and societies whose members are school boys and girls, artisans, office employees, teachers and preachers, professional men and scientists. They observe meteors, make telescopes, construct radios and talk with one another around the world; they catch butterflies, collect fossils and plants, take photographs, experiment with chemicals, and construct flying machines. They do not believe in magic or the performance of miracles. In their minds and hearts are the stately mansions to which the poet Holmes referred. They are the ones who can bridge the chasms between professional scientists and the millions who regard science as magic.

In the interest of the advancement and appreciation of science, and for the progress of civilization, these hundreds of thousands of organized amateur scientists should be encouraged and assisted by professional scientists and scientific organizations. The obligation of aiding them falls most heavily on the AAAS, because no other society covers all the various fields in which the amateurs are interested or has members in every community in which their organizations exist. They would be greatly stimulated, for example, by a special publication for such organizations and by speakers at joint annual meetings of the various amateur and local professional groups that exist in every American city.

The foregoing suggestion does not imply that the meetings of the Association should be discontinued. They will be continued, perhaps undergoing evolutions to meet changing conditions, as they have in the past. The suggestion is for the purpose of more effectively making this world *one world of science* in all its hopeful implications. There are promising possibilities. Conditions are favorable for new and important undertakings by the Association. It owns an ideal site for a permanent home that probably can be obtained almost for the asking. The difficult task is to formulate sound plans, and by crusading zeal to put them into effect. Noble aspirations and altruistic zeal have dotted this land with colleges, libraries, and other cultural institutions. They are its *glory*; its *grandeur* is in the stone and steel of its towering factories.

Howard A. Meyerhoff—Administrative Secretary

At a meeting of the Executive Committee of the AAAS held on September 13, 1948, Dr. Howard A. Meyerhoff, professor of geology and geography in Smith College, Northampton, Massachusetts, was unanimously elected administrative secretary of the Association for a term of four years, beginning January 15, 1949. He will be the tenth secretary to administer the operations and finances of the Association.

Dr. Meyerhoff, now 49 years of age, is in the prime of life—robust physically, experienced in teaching and academic administration, author of various geological researches, and consultant on the mineral resources of the Dominican Republic, Puerto Rico, the Virgin Islands, and Argentina. His contacts with contentious humans while serving on the War Labor Board and his financial experience in participating in the reorganization of a local industrial company have been valuable training for meeting the human and financial problems of a scientific society having 42,000 members and income and expenditures of about $500,000 per year.

The activities and interests of the Association extend into every field of science, directly through its 15 sections and indirectly through its 208 affiliated and associated societies and academies of science. In a real sense the Association is a unifying influence in the rapidly increasing expansion and diversification of science. Its great programs provide a common meeting ground for all the various scientific disciplines that together constitute the world of science. A leader of Dr. Meyerhoff's experience and qualities is required in order to carry the responsibilities now placed on him.—F.R.M.

The Membership Campaign

John M. Hutzel, *Assistant Administrative Secretary*

DESPITE THE FACT THAT MEMBERSHIP ACTIVITIES have been curtailed because of preparations for the Centenary, marked progress has been made within the past two months toward the centennial goal of 15,000 new members in 1948. The number of persons who have joined the Association this year is now in excess of 11,000, and it is expected that the activities of more than 200 local committees will result in the attainment of the 15,000 goal before the end of the year. Lists of prospective members sent by the local membership committees reach this office daily. These vary from proposed nominees to names of persons who have indicated their desire to join the Association. Approaches are being made through articles in local newspapers, house organs, and other publications and by announcements at meetings and over the air by way of university radio stations.

Interest in the membership campaign has stimulated the organization of local AAAS chapters in Richmond, Virginia; Springfield, Massachusetts; Queens County, Long Island; and Baltimore, Maryland. Temporary officers have been installed for the inauguration of many other chapters. Some of the chapters have already held meetings; others of more recent origin are planning programs for the months immediately ahead.

The Baltimore chapter, for example, held its first meeting at the University of Baltimore on September 3. The second meeting, attracting 80 persons, convened October 15 on the campus of The Johns Hopkins University to discuss "Personality, Analysis, and Adjustment." The November session will center about the use of atomic energy and its social and industrial implications. Both members and nonmembers of the Association are invited to attend the Baltimore meetings.

The Springfield chapter held its first meeting on November 4. Keynote of the accompanying exhibition was "Science in Industry," the proceeds from which will be used to cover the costs of the meeting and to establish a scholarship fund for "some deserving graduate of any of the city's high schools."

The adopted method of financing local activities is through the payment of nominal annual dues ($1.00 to $2.00) by the chapter members. Present high operating costs prevent outright financial assistance by the Association, other than for incidental expenditures attendant on the work of the organizing committees.

A uniform organization for the governing body of each chapter has not been established, but the pattern of administration of the Association will serve as a guide to help insure equal representation among the various sciences. In addition to the elected administrative officers of a chapter, two members, a chairman and a secretary, may be elected as committeemen to represent each of the Association's 16 sections, such as the Sections on Mathematics, Physics, Geology, Botany, Medicine, and Education, and to serve ex-officio on the Chapter Council. The secretaries of the local semiprofessional and professional scientific societies may also be approached to serve on the Chapter Council and be ex-officio members of the section committees according to their fields of interest. The responsibility for organizing meetings, preferably of the symposium type, could then be rotated among the section committees. The number of meetings to be held annually would be subject to the decision of the local council. They could be planned in cooperation with the state academies in order to coordinate and strengthen the scientific activities within each state.

The rapid growth of the Association reflects the mounting interest of men and women, both as scientists and as humanitarians, in accepting the unusual responsibilities created by recent developments in the pure and applied sciences. Through the medium of local chapters the opportunity is developing for the widespread integration of knowledge and thinking that can be reflected nationally and internationally by way of the Association's periodicals and through its representatives. Properly nurtured, the local chapters will become community enterprises of great importance, and they will strongly root the parent organization as a sounding board of a great cross section of American scientific opinion. As it grows internally, so also will the Association be able to cooperate more effectively with its sister societies throughout the world. In 1951 the AAAS will hold a joint meeting at Toronto, Canada, with the British and the French-Canadian Associations for the Advancement of Science.

Abstracts of Papers Presented at the AAAS Centennial Celebration[1]

GENES AND CYTOPLASM

Genes as Determiners of Cellular Biochemistry

David Bonner
Yale University

The mechanism which enables specific hereditary units (genes) to determine specific heritable characters is the subject of this review. The work discussed centers chiefly around one microorganism, a fungus, the pink bread mold, *Neurospora crassa.* This organism was selected for discussion since it affords at the present time the best material with which to correlate genic and biochemical changes.

Following ultraviolet irradiation, strains of this fungus have been isolated which differ from the ordinary strains found in nature by having to be supplied with the vitamin niacin for growth. Genetic investigations have shown that the requirement for niacin of these new strains is a heritable character, and results from the alteration of a single gene of the ordinary wild type strains, *i.e.* a single gene difference exists between the strains requiring niacin and the strains found in nature. A single gene determines, therefore, whether a given strain of this fungus can synthesize niacin. Biochemical investigations reveal that the inability of such strains to synthesize niacin results from the fact that these strains have lost the ability to carry out a single specific biochemical reaction. Thus, alteration of this single specific gene has resulted in the loss of a single specific biochemical reaction. Similar investigations of many other genes have invariably led to the same conclusion, *i.e.* that single genes control single biochemical reactions.

How do genes control biochemical reactions? Nearly every biochemical reaction that occurs in a cell requires the presence of a particular type of organic substance to enable the reaction to proceed. Such organic substances are catalysts called enzymes, and specific enzymes are associated with specific reactions. Since enzymes and genes are both chemically proteins, an attractive and plausible theory has developed, stating that genes exert their control of biochemical reactions by determining the specificity of enzymes, *i.e.* that the gene determines what reaction the enzyme can catalyze. Direct proof of this theory, however, is still lacking. Recent work in this field has demonstrated that loss of specific genes is associated with the loss of specific enzymes. The direct demonstration, however, of a gene alteration giving rise to enzyme alteration has not yet been carried out.

Current views regarding gene-enzyme relationship might, therefore, be summarized as follows: Single genes control specific biochemical reactions, and it is thought that this control is exerted through the determination of enzyme specificity. Stated another way, single genes determine the specificity of single enzymes. The mechanism whereby genes control enzyme specificity is still a major biological enigma.

How does such a theory relate to heritable traits in higher organisms such as man? The genetic control of biochemical reactions applies equally well to all organisms and has been demonstrated in a great many, including man. Biochemical differences appear not only as differences in growth-factor requirements for microorganisms, but as morphological differences such as skin color in man as well. All such traits are genetically controlled. In fact, there is little reason to suppose that the mechanism of gene action in microorganisms such as bacteria and fungi is substantially different from that of macroorganisms such as insects, higher plants, and mammals, including man. (Complete paper to be published in *Science.*)

The Effects of Changes in Quantity, Combination, and Position of Genes

Curt Stern
University of California, Berkeley

Genes are submicroscopic reagents. They come in pairs, since of any kind of genes the father and the mother each contribute one representative. If genes are large molecules, as assumed in general, a fertilized egg cell contains just two molecules of each genic kind.

Each genic species may occur in one or more varieties. It may make all the difference in the development of an individual whether the two molecules are of one variety or of the other: one will lead to an individual with full mental faculties, another to an imbecile; or one to a person with normal hands, another to one with hands having 7 fingers. That this pair of single gene molecules accomplishes such far-reaching consequences is one of the riddles of "gene physiology."

While we know that there *are* genes, we lack knowledge of their exact make-up. If we knew their chemical structure and could study the materials in the cell with which they react, we could unravel the threads which lead from the gene molecule to the external character. Lacking this knowledge, we still can study some aspects of our problem. For instance, in favorable cases we can vary the quantity of a gene. Instead of two genes, a cell can be made to have only one or three genes. Will it make a difference in the outcome if an egg starts development with one, two, or three doses of a gene? Or, what happens if the two genes of a kind belong to slightly different varieties? Will their joint effect be more or

[1] In the absence of an abstract, title and author's name are listed.

less or the same, as compared with the effect of one variety alone? Still another question: Genes are located at specific spots at specific chromosomes of the cell nucleus; if we artificially change the location, by shifting the genes to new chromosomal places or by shifting and replacing some of the chromosomal material near to them, will the genes now cause different effects?

Experiments which should help to answer such questions were performed with the fruitfly, *Drosophila*. The gene study affected the length of a certain vein on the fly's wings. Measuring the length of this vein in flies which started out with different quantities of the gene, different combinations of its varieties, or different positions of the gene, provided a method akin to the chemist's titration procedures of evaluating the effects of the different genetic conditions.

The results indicate that increasing the number of gene molecules results in increase of gene effect. This means that the cellular material with which the genes interact is not exhausted by the action of one or two doses of gene but is present in excess. It is further found that a gene variety which causes partial lack of vein (in contrast to a gene variety which leads to presence of a full vein) makes for more vein if the gene is increased in quantity. In other words, it is not a gene for lack of vein but rather a gene for production of some, but not sufficient, vein material. Another finding arose from the study of the effect of combinations of gene varieties. It turns out that two different varieties of a gene interfere with each other's activities. Their joint action may be less than that of either one alone. Finally, shifting the position of the gene will change its effect, many different positions being responsible for many different actions.

Someday the biochemists will discover the underlying details of these processes. In the meantime the manipulation of gene quantities, combinations, and position gives us insight into the small-scale processes in the cell and its nucleus which are responsible for the course of development. (Complete paper to be published in *Science*.)

Genes and Cytoplasm in Cellular Heredity

Tracy M. Sonneborn
Indiana University

The cells of which organisms are composed consist of a nucleus, with its genes and chromosomes that control Mendelian heredity, and of cytoplasm. It is well known that the cytoplasm protects the genes, nourishes them, is the site of activity of their products, and manifests the results of their activity. May the cytoplasm also play a part, comparable to that of the genes, in controlling heredity traits?

The existence of hereditary differences among genically identical cells and organisms is demonstrated by a number of examples in microorganisms, higher plants, and higher animals. In these examples the hereditary differences are cytoplasmically controlled. Though often ignored, this should be recognized as one of the capital facts of biology. What is the physical basis of this fact? How does the cytoplasm exert its determinative action? In a few cases the physical basis lies in visible self-multiplying cytoplasmic bodies. The most significant fact in the remaining cases, nearly all of which seem superficially to be independent of the genes, emerges from a study of the inheritance of specific substances in *Paramecium*. Here the genes of each individual control a series of alternative potentialities, and the cytoplasm controls which of the potentialities will materialize and be transmitted to the progeny.

Three hypotheses for interpreting these results are discussed: (1) the variable gene activity hypothesis—the activity of a gene varies directly with the cellular concentration of its cytoplasmic product; (2) the hypothesis of alternative steady states—high cellular concentration of the direct or indirect product of one gene inhibits the reactions leading to products of another gene and vice versa; (3) the plasmagene hypothesis—the genes control the production in the cytoplasm of self-multiplying materials that form a competitive system. The first hypothesis is held to be insufficient, but the other two are both formally acceptable. Points for and against these two are discussed, and decisive tests of them are proposed.

Regardless of what hypothesis of cytoplasmic control turns out to be correct, the primary fact remains established: the control of hereditary cellular traits is in these cases cytoplasmic and self-perpetuating. The cytoplasm, as well as the genes, plays a decisive role in determining hereditary traits.

HIGH POLYMERS

Structure and Behavior of Rubberlike Substances

Hubert M. James
Purdue University

The other papers of this symposium deal with dilute solutions of high-polymer molecules; this paper deals, instead, with rubber-like substances which are made up entirely of these molecules.

Rubber is prepared from liquid polyisoprene ("milled rubber") by vulcanization, a process which introduces a relatively few chemical bonds between the polyisoprene molecules. These bonds unite the long, flexible molecules into a flexible but coherent network without otherwise modifying much the liquid-like structure of the material; this is why rubber is easily deformed, without being easily pulled apart.

The useful properties of rubber do not depend on its special composition, but only on its being a strong and flexible network of molecular chains with a freezing point below ordinary temperatures. Knowing this, the rubber chemist knows in a general way how to proceed in producing a new synthetic rubber. He must start with, or arrange for the production of, long flexible molecules. He must choose molecules which do not exert large forces on each other; otherwise, he will get a glassy or hard plastic. He must make sure that the

molecular chains are not too easily packed together into crystals; otherwise, he will get a rigid crystalline solid. Finally, he must arrange for the linking together of these molecules at enough, but not too many, points; otherwise, he will get a viscous liquid or a brittle substance like the "hard rubber" of telephone mouthpieces.

To make it possible to predict how one can prepare a rubber-like material with desired special properties, it is important to gain a more detailed understanding of how the curious and complex behavior of these materials depends on their structure. This paper deals mainly with the explanation of the elastic properties of rubber, and with new ideas concerning the crystallization or freezing of rubber.

The elastic properties of rubber-like materials are much like those of gases, both in character and in origin. The pull of a piece of stretched rubber is due to the jerking of the molecular chains in it; these, like the molecules of a gas, are in constant motion. An increase in the temperature increases the violence of this jerking, and thus the tension in the rubber. The variation of this tension with stretch and temperature can be predicted theoretically for rubbers of especially simple ("ideal") structure and follows a simple law. Soft rubbers in general deviate little from this ideal behavior when they are not stretched too violently. Large deviations occur, however, when the rubber is frozen by violent stretching.

The freezing of rubber differs greatly from that of ordinary liquids. It has no definite freezing point, but freezes slowly over a wide range of temperature. Natural rubber is most readily frozen by stretching it violently; this raises its melting point to above the boiling point of water. The properties of frozen rubber depend in a surprising way on the temperature or extension at which it is frozen and on how long it is kept frozen. It will be shown how this behavior can be completely explained in terms of the known structure of rubber. "Supercooling" plays an important role in this behavior; so does the fact that the rubber molecules in a crystal are not all essentially identical (like the water molecules in an ice crystal) but are permanently distinguished from each other by their positions in the molecular network in the rubber. (Complete paper to be published in *Science*.)

Polyelectrolytes

Raymond M. Fuoss
Yale University

Polyelectrolytes are substances of high molecular weight which are simultaneously electrolytes. Synthetic materials of high molecular weight have become fairly familiar to the general public, thanks to the wartime synthetic rubber program and to the interest in synthetic textiles such as Nylon. Electrolytes are defined as compounds which will carry an electric current in solution; well-known examples are the sodium chloride (common salt) in sea water and the sulfuric acid in the storage battery. A number of naturally-occurring substances, such as proteins and polysaccharides, are known to have high molecular weight and are electrolytes as well. Their structure is rather complicated and has not yet been fully investigated. Furthermore, their electrical and hydrodynamic properties are quite unlike those of simple electrolytes. The properties of electrically neutral polymers and of simple electrolytes are well understood, in the sense that we have a molecular model which can be used to predict their properties in terms of fundamental parameters. It therefore seemed logical to synthesize linear polymers of known structure, convert these to electrolytes, and then study the properties of the products. In this way we may obtain at least an empirical correlation between structure and properties and eventually, by analogy, draw some conclusions concerning the biologically important natural polyelectrolytes.

Just as synthetic rubbers can be made which have properties not shared by natural rubber, we can make polyelectrolytes unlike those which appear in nature; in other words, we can start with rather simple structures and gradually increase their complexity. For example, weak electrolytes *i.e.* those which are only partially dissociated into ions which are free to carry the electric current are more complicated in their behavior than the strong electrolytes, which are completely dissociated at low concentrations. The natural polyelectrolytes are nearly all weak electrolytes so the attendant problems are added to those of unknown structure. Our initial program therefore consisted in the synthesis of long-chain *strong* electrolytes and a study of their properties.

Vinylpyridine is a substance much like styrene (vinyl benzene), one of the ingredients of synthetic rubber, with the significant difference that it contains a pyridine ring instead of a benzene ring. The vinyl group still will build the monomer into long chains, exactly as with styrene. After polymerization, the neutral nitrogen atoms in the pyridine rings in the polymer are converted into ionic nitrogens by the addition of alkyl halides such as butyl bromide. In this way, a long-chain strong electrolyte is obtained. By copolymerizing the vinylpyridine with styrene, other electrolytes with different (but known) distributions of charges can be made. Other methods of making synthetic polyelectrolytes have also been developed, but this example should suffice. Then the conductance and viscosities of solutions of these compounds at different concentrations and in different solvents have been measured. Just like polysaccharides from pneumococcus, these solutions have very high viscosities which are depressed by the addition of simple electrolytes like sodium chloride. The conductance data give a measure of the relative number of free ions and have shown that the intense electrical fields produced by concentrating many ions into the small volume occupied by the chain molecule lead to properties which resemble those of highly concentrated solutions, even when the polyelectrolyte is present in dilute solution. (The full article on which this abstract is based appeared in *Science*, 1948, 108, 545–550.)

Structure of Polymers in Solution

Peter J. W. Debye
Cornell University

The first and most elementary question to be asked about a polymer in solution is that about its molecular weight, and this question is answered at once by any experimental method which enables us to count the number of independent polymer particles distributed throughout the solvent. The classical method is a determination of the osmotic pressure, and this easily gives the desired result, fundamentally because at a given temperature all particles, no matter how different their structure may be, have the same translational energy. However, the higher the molecular weight, the smaller is the number of individual particles in a given weight and the smaller is the observable osmotic pressure. Apart from the experimental difficulties connected with any experiments on osmotic pressure, this was the reason why I thought it advisable to see whether a better method, especially adapted to the heavy particles generally encountered in the polymer field, could not be found.

During the war years and in connection with the Rubber Reserve Program such a method, which becomes easier to handle with increasing molecular weight, has been developed; it consists in measuring the intensity of the light scattered by the solution as compared to the intensity of the primary beam which passes through the liquid. In dilute enough solutions the scattered intensity is, of course, proportional to the number of particles, which is what we want to measure. However, nothing analogous to the simple equipartition law mentioned in connection with the osmotic pressure exists in this case concerning the light intensity. Whether a simple particle scatters more or less depends very much on its structure. But it can be shown that all we need to know in order to make our counting effective can be derived from an additional measurement of the difference in refractivity of solution and solvent. As a rule, to be sure, neither this difference in refractive index nor the turbidity is large. One unit in the third decimal of the refractive index and a turbidity equivalent to a loss of 1/mil in intensity of the primary beam/cm is the order of magnitude in customary polymer solutions at 1% concentration. But both these effects can easily be measured with satisfactory precision. Recently, in collaboration with R. H. Ewart, of the U. S. Rubber Laboratories, it could be shown that turbidity measurements can also be used to give information about the extent of preferential adsorption by the polymer in mixed solvents.

A coiling straight-chain polymer of higher molecular weight occupies rather a large space in a solvent. Even if we believe for the moment in absolutely free rotation around bonds and no mutual interaction of the parts of the chain, the spherical space occupied on the average by a polystyrene molecule of 1,000,000 molecular weight can be calculated to have a diameter of 300 Angström units. This is already 1/10 of the wave length in the liquid of the light usually employed in measuring light scattering. In such a case appreciable differences in phase must exist between the rays of scattered light coming from different parts of the same molecule, and this should lead to interference effects fundamentally of the same character as those observed in X-ray or electron scattering by single molecules of low molecular weight. As a matter of fact, it is observed that solutions of such heavy-weight polymer particles scatter more light in the forward direction (direction of propagation of the primary beam) than backward. It is only necessary to compare the two scattered intensities in directions making angles of, say, 45° and 135° with the direction of the primary light in order to measure directly the size of the polymer molecule in solution. Such measurements reveal that this size generally is a good deal larger than expected from current estimates based on free rotation around bonds and missing interaction between parts of the chain. So, in this way we arrive at an estimate of the actual chain stiffness.

Intimately connected with the angular dissymmetry effect is the appearance of an anomalous dependence of the intensity of the scattered light on the wave length, which for very small particles (the normal case) obeys Rayleigh's law, being proportional to the reciprocal 4th power of the wave length. For this reason another method for measuring sizes can be based on observations of the dependence of the scattered intensity on the color of the primary light. This method can be handled most easily, especially for relatively large particles.

Addition of a small amount of a coiling polymer to a large volume of a solvent gives a large increase of viscosity. Thinking of the large-size chain molecules involved which link very distant parts of the solvent with each other makes the qualitative explanation of this effect obvious. Since Staudinger, the viscosity increase measured by the intrinsic viscosity (the relative increase of viscosity per concentration unit) has been used extensively in order to obtain estimates of the molecular weight. The intrinsic viscosity is not, as first supposed by Staudinger, proportional to the molecular weight. According to a suggestion of Mark, it can usually be represented over a large range of molecular weights as proportional to a power-function of the molecular weight, mostly with an exponent somewhere between 1 and ½. Since neither the proportionality factor nor the exponent can be derived from any other measurements than those on the viscosity of solutions of the same kind of polymers of known molecular weights determined in some other way, it cannot be called a method for the determination of molecular weights. On the other hand, viscosity measurements are very easy to make, and, provided the experimental results can be properly understood, they should reveal some probably interesting features of the polymer structure. The actual motion of a polymer molecule and its parts in a liquid flowing as it does in some experimental arrangement used for measuring viscosities can be analyzed. In this way it can be shown that the intrinsic viscosity should be proportional to the

average square of the distance of the average monomer group of the chain from the center of gravity of the whole molecule. But this average square of the distance is proportional to the number of chain links and therefore to the molecular weight. So it seems that, after all, theory leads to Staudinger's rule. However, a more thorough inspection of this theory reveals that in its development it is assumed that the molecule does not disturb the motion of the surrounding liquid in the least. Recently it has been possible to take account of this disturbance by a method which can be handled mathematically. In this way it appears as important that the molecule, as a result of the disturbance originating with each of the individual monomer groups, shields its interior parts nearer its center of gravity, more or less from the effects of the liquid flow at its outside. This shielding effect can be measured by a shielding length characteristic for the distance over which the outside velocity distribution makes its influence felt into the interior of the space occupied by the polymer molecule. Discussed along these lines the intrinsic viscosity becomes equal to the specific volume, or the equivalent reciprocal of the density with which the polymer molecule fills the average space it occupies in the liquid, multiplied by a correction factor which depends solely on the shielding ratio defined as the quotient of the radius of this space to the shielding length. With respect to the dependence of the intrinsic viscosity on molecular weight, it follows that for linear chain molecules it should be proportional to the molecular weight itself for small values and gradually, with increasing length of the chain, change to proportionality with the square root as the limiting law for very long chains. Mark's rule appears as an approximation adapted to the range of molecular weights under investigation, and its exponent is a measure for the shielding ratio prevalent in this range. In this way experiments on viscosity lead again to a determination of the size of the polymer molecule, and the comparison of intrinsic viscosities in different solvents has already shown in a quantitative way how the chain polymer coils up tighter with decreasing solvent power of the liquid. It will be interesting, in the near future, to confront size determinations from viscosity with those derived from the dissymmetry of light-scattering. (Complete paper to be published in *Science*.)

HOUSING

Housing in the Redevelopment of American Cities

Coleman Woodbury
Urban Development Study, Chicago, Illinois

For many reasons, housing has proved to be a difficult subject both for the formation of public policy and for research. Among these reasons is the fact that the term has several differing meanings. In one sense housing is the methods, practices, and policies under which houses are produced, maintained, owned, and used. A house, of course, may be looked upon as a structure, as a structure plus equipment, as a structure plus equipment plus the services provided by local government and other agencies.

As a matter of realistic fact, American families live not only in houses but in neighborhoods, in cities, and in metropolitan regions of which the individual cities are component parts. If we take the end objective of housing to be a decent environment for individual and family life, the neighborhood, the city, and the metropolitan region deserve our attention as much as the house structure and its equipment.

This paper outlines some of what I take to be the basic facts, problems, and research needs with respect to the neighborhood and the metropolitan region.

Two outstanding facts should be recognized at the outset:

(1) We have less reliable information and agreed-upon opinion with respect to neighborhoods and metropolitan regions than we have on houses and their equipment.

(2) Many metropolitan regions, in which about 50% of our total population now lives, show alarming signs of disintegration and decay. In large parts of the metropolitan areas, the neighborhood has all but disappeared. Blighted areas of different kinds are found in nearly all such regions. Every indication is that they are growing from year to year—some at a very rapid rate. If the American people are to have housing of the kind they have a right to expect from an economy as advanced and productive as ours, we must learn more about this process of disintegration and what can be done to overcome it.

During recent years several proposals have been made that would enable public or private agencies to acquire sizable blighted areas, clear them, and make them available for redevelopment. A few of these plans are now being tested on a small scale with funds provided by state and local governments. Undoubtedly we shall see, during the next 15 or 20 years, much more interest and activity of this kind. If this work, however, is to be wisely and effectively done, we must learn more than we now know about the organization and economy of metropolitan areas. Surgery on the blighted districts should not proceed without knowledge of the history of the patient and a reasonably complete diagnosis of the ills of which the blighted districts are themselves the most painful symptoms. I suggest that we need analysis, research, and discussion in at least 5 subareas or fields:

(1) *The metropolitan region as a complex plant in which the business, industry, and day-to-day life of its citizens are carried on.* What are the relative advantages and disadvantages of centralized development *vs.* open development? What are the real costs of congestion? How do urban structure and density affect the costs of municipal services, the loss of time and energy in travel, the expenses of conducting business and industrial operations? Would we be better off if our large metropolitan areas were built up in a number of medium-sized satellite towns rather than as a more or less continuous develop-

ment? In an age of atomic and biological warfare, what effects should defense and security considerations have upon desirable urban patterns?

(2) *The city as a place to live.* Is the decline of urban neighborhoods inevitable? Do city dwellers want the kind of life that real neighborhoods make possible? Are we evolving a substitute for neighborhood units that are better suited to life in these times? Does the spread of suburban towns throw any light on these questions?

(3) *Government organization in metropolitan areas.* To what extent are the blight and disintegration of districts within metropolitan regions due to the disorganization of government services and facilities? What steps seem feasible to help correct this condition?

(4) *The planning function in metropolitan regions.* City planning is now recognized as a necessary and desirable function, but it is still weak and ineffective in many respects. How can it be improved and applied to the trends and problems of the larger metropolitan districts?

(5) *Local tax systems.* To what extent do the present systems of local taxation contribute to blight and disintegration? What have we to learn from recent experiments with newer forms of local revenue?

In this broad field of metropolitan economy and life, questions are much more apparent than reasonable answers or solutions. To ask the right questions, however, is certainly the first step. After them must come hypotheses concerning the basic relations and then tests and reformulation of these hypotheses.

I do not suggest that research in these phases of urban redevelopment should prevent us from pressing forward on other housing fronts. I do suggest, however, that we will never fully understand the housing problems of this country or be in a position to outline effective housing policies until we give much more attention and study than we have so far to these broader problems of urban neighborhoods and metropolitan areas.

The Contribution of Science to Housing

Livingston Houston
Rennselaer Polytechnic Institute

In spite of the fact that science and engineering have developed principles, techniques, and materials for the mass production of comfortable and hygienic homes, our present low standards of housing constitute one of the most acute problems with which this Nation has ever been faced.

If we conceive of the pattern of American living in terms of well-planned communities and well-built homes, we must begin at once to apply the findings of science to our problem.

A wider understanding by the public of the contributions which science can make to housing is essential. As a result of this understanding, local building codes can be unified and modernized to take advantage of newly developed materials, and restrictive labor practices can be eliminated to utilize newly developed techniques.

A central agency to correlate the findings of science and to give these findings the broadest dissemination is a necessary first step toward meeting the crisis. Other necessary steps are soundly financed, government-aided housing for the lowest-income groups and a great amount of self-supporting public housing for our large middle-income group. Although we cannot now afford a large-scale slum clearance program, we must ultimately, for our own national health and welfare, eliminate all slums and blighted areas.

Housing: Where the Natural and Social Sciences Meet

Bryn J. Hovde
New School for Social Research

Until very recently the natural and the social sciences have developed more or less separately. There has even been a moderate degree of rivalry between them for the approbation of the public. In this rivalry the natural sciences are obviously far ahead of the social sciences, and yet we realize more and more that the solutions of the great problems now confronting the world must be discovered in the realm of human relationships rather than in that of the natural sciences. Furthermore, with the increasing integration of the world it is clear that the natural and the social sciences depend very much upon one another. Hence, they must, for their own sakes alone, as well as for the service of mankind, meet on good, common ground and work together. Such a common ground is the housing problem, now so acute throughout America and the world.

The housing problem and its corollary, town planning, require the closest cooperation of all the sciences. On its face this problem will inevitably seem to be more of a social problem than a scientific one. In that respect, however, it does not differ greatly from most of the paramount issues now confronting mankind. Hence, it ought to be possible to effect a good division of responsibilities between the two great branches of science, and at the same time such a degree of direct cooperation between both natural and social scientists as will enable social scientists to learn from the natural ones a more perfect scientific method and natural scientists to learn from the social ones greater concern for the kind of world in which mankind has now to live.

It would seem to be the primary obligation of the social sciences to provide the necessary data on the people who are to be provided with housing, the different kinds of housing that people of different incomes can afford, and want, and need. These matters greatly affect the design of any house or apartment building, and at this stage the natural scientist enters the picture to provide solutions for very concrete problems relating to types of materials, substitute materials, materials of different cost and quality, and the basic standards on which all housing must be built and maintained to remain standard and fit for human habitation. The natural scientists are indispensable and have a primary responsibility in all

biological and technical matters. But in the field of housing they cannot make their best contributions by working alone and on small, isolated scientific problems. What is needed is a national housing research agency, very broad in scope, which will team the natural scientists with the social scientists in a progressive and evolutionary study of housing problems.

HUMAN INDIVIDUALITY

Primary Mental Abilities

L. L. Thurstone
University of Chicago

Until rather recently it was customary to appraise the mental endowment of children and adults by psychological tests that gave a single index of intelligence, such as the mental age or the intelligence quotient. These indices were very useful in estimating the mental endowment of school children. The serious limitation of the I.Q. as an estimate of mental endowment is that two men may have the same I.Q. and yet be totally different in the mental abilities that they possess. The fundamental problem in this field is, therefore, to isolate and to describe the distinct mental abilities which constitute mental endowment.

During the past 20 years the multiple-factor methods have been developed as new scientific methods especially for the solution of this problem. In the experimental and analytical work with the factorial methods a number of the basic or primary mental abilities have been isolated. The tendency now is to describe an individual's intelligence in terms of a profile that shows his rating in each of the distinct mental abilities. The mental profile is much more useful than any single index in describing the abilities of each person.

Following is a brief description of some of the primary abilities that have been isolated so far.

There are several distinct mental abilities that are associated with the visualization of objects in space. One of these is the space factor S. Most people who are intelligent are fairly well endowed with this factor, but there are many highly intelligent people who are conspicuously poor in this primary ability. Most scientists are good visualizers. It has been found that the ability to handle numerical work is a primary factor which has been denoted N. A cashier would soon quit his job if he were poor in the number factor. One of the socially most important primary mental abilities is verbal comprehension V. It is represented rather well by tests of vocabulary. Another verbal factor is word fluency W. It is quite distinct from the verbal factor V. A person can have a high score in verbal comprehension indicating a capacity for profound verbal reasoning and yet have a low score in word fluency. Another person may be very fluent although he has a limited vocabulary.

It has been found that the ability to memorize is a primary factor quite independent of the other mental abilities. One of the most interesting is the mental ability that enables one to discover the rule or principle in the material with which one is working. This ability has been called induction. It is not yet known whether it is associated with originality or creativeness.

In the field of perception several basic or primary abilities have been isolated. One of these is speed of perception. It has been found, for example, that inspectors in some types of work are more efficient if they possess the factor perceptual speed. Other perceptual factors have been called visual and auditory acuity. For example, two individuals may have the same degree of hearing difficulty as determined by acuity tests; one of them may succeed fairly well in understanding what people say, whereas the other has trouble in understanding what he does hear. The difference is caused by the closure factor that enables one person to fuse what he does hear into meaningful speech where the other person fails in this regard.

Experiments at different age levels have revealed essentially the same primary mental abilities. The experiments included groups of college students, high school students, eighth-grade children, and finally, kindergarten children. Some primary mental abilities can be estimated in young children even before they have learned to read. Experiments are under way to determine whether teaching methods should be adjusted to fit the mental profile of the children.

A one-year curriculum has been prepared for training the mental abilities of kindergarten children. It consists of a new game each day, the games being designed to train young children in space and perception, verbal comprehension, and inductive reasoning. Young children of this age are better in reasoning than we ordinarily believe. Adults carry out most of their reasoning in the verbal medium, which is not well developed in young children. It has been found that the mental profile has a close relation to the ways in which an individual tries to solve his personal and emotional problems. The central idea in this work is that human intellect consists of a large number of distinct mental abilities that are called primary factors. Each individual is described in terms of a mental profile instead of by a single index such as the I.Q.

The Individual and the Culture Process

Leslie A. White
University of Michigan

A conception of the individual as a prime mover, the source and basis of human behavior, is widely held in cultural anthropology and related sciences today. A corollary of this proposition is that, since the individual is the determinant of sociocultural phenomena, these must be explained in terms of the individual.

Thus, various anthropologists have asserted that every element of culture has been created by the individual, that culture is nothing more than the responses of society's individual members, and therefore the individual is the logical starting point for any investigation of sociocultural phenomena. We find these propositions unsound.

We grant, of course, that culture is dependent upon the human species and could not exist without it. It is obvious also that the human species is composed of discrete

biological entities which we call individuals. It is apparent, therefore, that culture finds its expression in the behavior of individual human organisms. But it does not follow that the culture process can be explained by invoking the individual as a prime mover, as an innovator or determinant. On the contrary, we would take the position that the individual is irrelevant to an explanation of the culture process.

Culture is an organization of beliefs, customs, tools, utensils, etc. that is dependent upon the ability, unique in man, to use symbols. It is a continuum, a cumulative tradition, passed down from one generation to another. Everyone is born into a cultural tradition that embraces him at birth and equips him with beliefs, attitudes, customs, tools, etc. *Human* behavior, as distinguished from *primate* behavior, is the response of an organism of the species *Homo sapiens* to a cultural tradition. It is culture, not the human organism, that determines such differences of behavior as that between Chinese and Swedish, or the difference between the behavior of the English people of A.D. 1000 and of A.D. 1900.

Culture as such is not explainable in terms of individual psychology; in fact, it is not explainable in terms of psychology at all. Culture *as culture* can only be explained in terms of culture, *i.e.* culturologically. Culture is a stream of elements that are continually interacting with one another, forming new combinations and syntheses, eliminating some elements from the stream, and incorporating new ones. This stream, this culture process, has its own principles and its own laws of change and development. Just as the linguistic process is explained philologically, so the culture process in general is explained culturologically rather than psychologically.

Human organisms are, of course, essential to the existence of the culture process. But culture cannot be explained in terms of these organisms. We can, however, explain the behavior of the individual in terms of the culture that embraces him. In the culture process the individual acts as a catalytic agent, making the interactive process possible and continuous. But from the standpoint of an interpretation of the culture process, the individual is merely the locus of its existence and the medium of its expression, not its creator or determinant.

The Genetic Approach to Human Individuality

Laurence H. Snyder
The University of Oklahoma

No two human individuals are exactly alike. Yet all human beings possess certain traits in common. The similarities and differences observable and measurable among people are the results of the interaction of genetic and environmental influences. Modern genetic methods are successfully distinguishing between the relative contributions of these interacting influences, and indicate that the proportionate extent of these contributions differs from trait to trait. Significant genetic components are known to many traits—among them, the hemagglutinogens, which in various combinations form the 2,000,000 blood groups; the enzyme systems involved in metabolism; the taste deficiencies; anomalies of the eyes, muscles, nerves, glands, blood, skin, hair, teeth, nails, and other body organs and systems.

Genetic analysis of human beings is made through two main channels: Mendelian genetics and population genetics. The principles of both must be understood and used in order to understand human individuality. Among the findings emerging from the study of population genetics is the conclusion that human populations differ genetically one from the other almost entirely in the varying *proportions* of the alleles of the various sets and not in the *kinds* of alleles they contain.

The manifold combinations of traits which in turn derive from manifold combinations of genetic and environmental influences result in the almost infinitely diverse range of human individuality—a range which we are just beginning to comprehend.

WORLD'S NATURAL RESOURCES

The Exploitation of Mineral Resources

T. S. Lovering
U. S. Geological Survey, Tucson, Arizona

The efficiency and adaptability of an industrial civilization are dependent on minerals as well as on men; the search for minerals and the exploitation of rich deposits were vital factors in world power in the time of Alexander the Great; they are increasingly crucial today.

Minerals are finite, expendable resources which year by year become more expensive to discover and to exploit. The geology of a region predetermines the kind and quality of mineral resources locally available, and no industrial country has within its borders adequate supplies of all the minerals essential to its economy. The world's known supply of several strategically important minerals is localized in a very few widely separated areas.

Mineral exploitation in many countries has shown a common pattern: flush production of cheaply produced minerals at an early stage, attended by quick wealth and power, is followed by declining output, acquisition of foreign sources of ore, and appreciable imports; later, as domestic mineral production becomes increasingly expensive and mineral imports contribute more and more to industry, the economic advantage of cheap raw materials is lost, and social, economic, and cultural strains result. Great Britain passed its peak in the production of lead, copper, tin, iron, and coal between 1856 and 1913 but at times was the world's largest producer of these products. The United States has passed its peak for mercury, lead, and possibly a few other metals but has reserves of iron, coal, phosphate rock, and molybdenum ore that should meet all demands for generations, and the supplies of copper, zinc, aluminum, gold, and petroleum should be adequate for another 20 years. Known reserves of lead, manganese, and vanadium ore would hardly last a decade at present consumption levels unless supplemented with substantial imports. Domestic deposits of platinum, antimony, mercury, tungsten, chromium, nickel, tin, mica,

graphite, asbestos, diamonds, and quartz crystal are negligible, and these commodities must be largely imported.

The Soviet Union probably has not yet reached peak production in any of its important mineral resources, but like other industrial nations, it has an ever-growing concern for the position, extent, and availability of mineral deposits at home and abroad.

To avoid industrial or military conflict over the scattered major foreign sources of cheap raw materials several steps should be taken to lessen the industrial dependence on imports of the strategic minerals. Substitutes should be sought among combinations of metals that are readily available; metallurgical research must anticipate future shortages years before they arise. Similarly, preparations should be made now to exploit low-grade, currently noncommercial deposits in the most efficient way when their more expensive contribution is finally necessary.

Discovery of mineral deposits is still an art rather than a science; much fundamental chemical and physical research in suitable laboratories will be required before either oil or mining geology has a sound scientific basis. Thanks to the field geologist, our empirical knowledge of geologic relations is increasing steadily, and this is at present our chief hope of improving discovery rate. Geophysical and geochemical field methods have been very helpful in many places, but their scope is still relatively limited. Research directed toward discovery of hidden deposits is urgently needed; it should be carried on in field and laboratory by cooperating groups of physicists, chemists, and geologists, and the validity of conclusions reached should then be checked. Beyond such research however, we desperately need wise planning for economic and equitable utilization of the world's widely scattered deposits. To this end geologic work, exploration, and reserve estimates should be accelerated in all countries so that an inventory will be at hand for use by the next generation in planning those global economic units that will most effectively utilize our planet's resources to the maximum benefit of all mankind. (Complete paper to be published in *The Scientific Monthly*.)

On Living in the Biosphere

G. E. Hutchinson
Yale University

The region of the earth which can be inhabited is called the biosphere. It is suitable for life because of its temperature, its composition, and its continually received supply of radiation from the sun.

Processes that occur in the biosphere which change it permanently are called *acyclic*; those not changing it, *cyclic*.

The effect of man on the cycles of carbon and phosphorus is examined. Most of man's activities tend to make processes less cyclic and so change the biosphere, making it less suitable for life. We have reached a point in this process when human assets are the only thing that we have in abundance. Any future economy of abundance must be based on human ingenuity rather than on abundance of raw materials. The main obstacles to such a development are fear of war and a wrong orientation on the part of the public toward natural resources. Exploration of our culture with a view to finding forces working in favor of a more constructive attitude is essential. An example from the advertising field is discussed. (The full article on which this abstract is based appeared in *The Scientific Monthly*, 1948, 67, 393.)

Plants and Vegetation as Exhaustible Resources

Stanley A. Cain
Cranbrook Institute of Science

It is the thesis of this address that much of man's basic needs for food, clothing, and shelter—with which his economy has always been concerned—are directly or ultimately of plant origin, and that these natural resources are not quantitatively adequate to permit a continuing consumption at present world rates, with the result that men everywhere must face squarely the dual problems of the conservation of natural resources and the limitation of population or continue along the path, with an accelerating rate, toward self-destruction.

The nature of vegetal resources, both as direct products from plants and as vegetation, is reviewed. Attention is also paid to the growing depletion of the world's resources, especially to the causes of the modern acceleration in resource-capital exhaustion and population increase, and to the sociopolitical effects that accompany the inevitable lowering of the level of living. There are favorable factors in the picture, such as technological production advances, the discovery and invention of substitutes for critical materials, and a growing public awareness of, and attack on, conservation problems. But these advances are far from solving the ultimate dilemma.

The successful education of the people in conservation is dependent to a large degree on their general education in economic and sociopolitical fields, as well as in a comprehension of the more direct problems of natural resources. Such education processes are slow, even in countries with a high percentage of literacy. They seem overwhelmingly complicated in many countries where the rate of natural resource destruction is high or where, through past maladjustments, destruction is most advanced, and where perhaps two-thirds or more of the people cannot read. General education is a concomitant of a high level of living. How can that education come to pass where an abuse of the natural resources is keeping men from reaching a level of living where education about that abuse can be effective? It is the most vicious of chain reactions. We are living at a moment of great, and what seems justifiable, pessimism, and perhaps we too are the victims of a psychological chain reaction. But the dual problems of population control and of our dwindling resources seem to me ones that have even less likelihood of a solution friendly to man than the control

of the atomic bomb. (Complete paper to be published in *The Scientific Monthly*.)

INTERACTIONS OF MATTER AND RADIATION

New Properties of the Electron

Willis E. Lamb
Columbia University

Observations on Slow Mesons

C. M. G. Lattes
University of California, Berkeley

The method of detecting charged particles by means of photographic emulsions has proved to be useful in the study of slow mesons. Since the plates are continuously sensitive, rare phenomena can be recorded over periods of the order of one month. The stopping power is about 2,000 times as great as air, so that it is possible to find large numbers of particles which stop in a unit volume of the emulsion. This property makes the plates useful for the study of relatively rare events such as the stopping of a cosmic-ray meson. This paper describes work at Bristol, England, in detecting mesons from cosmic rays and work at Berkeley in detecting mesons produced by the 184″ cyclotron.

By making use of reactions of light elements, the Bristol group measured ranges of protons of known energies, from which they were able to plot a range-energy curve. From the lengths of the most energetic protons which could be seen in the plates, it was estimated that mesons would be visible up to about 4 Mev in Ilford C.2 plates. Plates exposed for study at Bristol were placed, in their original containers, in the Pyrenees at an altitude of 2,800 m and in the Andes at 5,500 m. Examples of events found, including long proton tracks, stars, "hammer tracks," and events involving mesons are shown. The meson events were found relatively infrequently. Meson tracks are distinguished from tracks of heavier particles by larger scattering and more rapid change in grain density. From the phenomenological point of view there are four types of mesons: (1) ρ-mesons, which slow down and stop uneventfully, without giving any other particles whose tracks are observable in the emulsion; (2) σ-mesons, giving "stars"; (3) π-mesons, giving secondary mesons of constant range and smaller mass; and (4) mesons coming out of stars. An interpretation of the different types, and the relative frequency of occurrence, is given.

A consistent picture can be obtained by assuming that most of the ρ-mesons are positive and negative mesons of the type responsible for the hard component of cosmic rays at sea level. The π- and most of the σ-mesons are of heavier mass and have stronger interaction with the nucleons.

Negative and positive heavy mesons have been observed in the vicinity of the target of the 184″ Berkeley cyclotron. Yields at different bombarding energies are given and mass measurements described. Most of the heavy positive mesons give rise to an observable secondary meson. Approximately 75% of the heavy negative mesons give rise to stars when they come to rest in the emulsion. No secondary mesons are observed to start at points in the emulsion where the heavy negatives stop. The origin of light positive and negative mesons, also observed in plates exposed at Berkeley, is discussed.

How Mesons Disappear

John A. Wheeler
Princeton University

The mesons which constitute three-fourths of the sea-level cosmic radiation, and which have a mass about 200 times that of the electron, disappear mainly in decay processes in which one electron is emitted.

To take up the recoil in this process there must come off at least one other particle. This particle is not seen and is therefore electrically neutral. Whether one or two neutral particles come off is not known. According as one or two neutral particles emerge there will be a difference in the energy distribution of the electrons given off in a large number of such disintegration processes. The energy spectrum has been calculated on the following three alternative assumptions: (a) one neutral particle of zero rest mass (a neutrino) is emitted; (b) two neutrinos are emitted along with the electron; (c) the electron is accompanied by one neutrino and one neutral meson of rest mass 20–90 times the mass of the electron. The neutral meson in case (c) might or might not be identified with the neutral meson which is known to be given off when a heavy (300-mass) meson gives off a normal (200-mass) meson. The calculated curves are compared with the available experimental evidence to draw conclusions about the nature of the important elementary particle transformation in which a meson decays.

Not all the normal mesons observed at sea level undergo decay. Some of the negatively charged ones interact with atomic nuclei. Preliminary experimental and theoretical evidence makes it reasonable to believe that the meson loses its charge in the process but is not destroyed. The charge transfer converts one of the protons in the nucleus into a neutron and imparts excitation energy to the nucleus. It is possible to understand in this way the nuclear disruptions produced by normal sea-level mesons. Similarly, one can foretell the possibility of a process of meson-induced nuclear fission which has not yet been observed.

SOURCES OF ENERGY

Solar Energy

Farrington Daniels
University of Wisconsin

The radiation from the sun amounts to about 1 kcal (1 large calorie)/sq ft/min in the temperate zone, or 7,000,000,000 kcal/acre/year. The present and future utilization of this energy is considered. There is apparently enough energy, if used properly, to meet the needs of the human race for food, fuel, and power.

The direct utilization of sunlight for power is difficult because the temperature is too low, but the energy is conveniently converted into the organic material of grow-

ing plants, where it can be conveniently stored and burnt with air at high temperatures to operate heat engines. The maximum conversions which can be realized is about 20% of the effective sunlight actually absorbed. Moreover, only about half of the sun's radiation is effective, and in the Temperate Zone the growing season is limited to about a third of the year. The maximum conversion of energy is then limited to about 3.3% in plants grown in the United States. Some of the major agricultural crops utilize a few tenths of 1% of the annual solar radiation which falls on the area in which they are growing. Certain forest trees convert about 0.1% of the sun's radiation into stored energy. The reasons for these comparatively low efficiencies are discussed.

Photosynthesis is a process by which carbon dioxide and water are combined by sunlight in the presence of chlorophyll to give carbohydrates and other organic material. Several significant experimental facts of photosynthesis, including experiments with isotopic tracers, are described briefly, and the present hypothesis for the mechanism of photosynthesis is discussed. The energy of the light is not sufficiently great to cause the direct combination of carbon dioxide and water. Several steps are required, each made possible by the absorption of light by chlorophyll. Hydrogen atoms are probably transferred from the water to the carbon dioxide in a series of chemical reactions. It seems reasonable, then, that about 20% of the sunlight actually absorbed is the maximum that can be stored.

Finally, possible future developments are discussed with reference to the greater utilization of solar energy and the production of more food, fuel, and power. (Complete paper to be published in *Science*.)

Second Thoughts to the Problem of Nuclear Energy

Eugene P. Wigner
Princeton University

Atomic energy occupies an intermediate position between our present energy resources, such as coal, gasoline, and the very abundant source of energy which we receive as sunshine. Its great advantage is that the atomic fuel as such has practically no weight. Its principal disadvantage is that dangerous and very penetrating radiations accompany the burning of the atomic fuel. The neutralization of these radiations gives the machinery in which nuclear fuel can be used considerable weight and bulk. The principal effort in the design of atomic machinery is therefore toward making the machinery simple, light, and, at the same time, safe. On the measure of the success of this endeavor depends the fate of the hope that atomic energy may play a real role in our economic life. The outlines of two types of machinery which came to be regarded as conventional are shown.

The great concentration of power in the atomic fuels appears to make them ideally suited for use in transportation. However, the radiation which was mentioned before seems to block their use in vehicles of small size, such as automobiles. They may be more suitable for large ships which have to travel long distances. The use of atomic fuels in airplanes and rockets has not yet been explored sufficiently to venture an opinion. Every industrial use of atomic energy will have to be preceded by more thorough research and more intensive development work than we have so far been able to muster. (The full article on which this abstract is based appears in *Science*, 1948, 108, 517.)

Energy From Fossil Fuels

M. King Hubbert
Shell Oil Company, Inc.

It is difficult for those of us living today, especially in the more industrialized areas of the world, to appreciate fully the unique character of the events which we are witnessing. All of our lives, and for the immediately preceding century whose history is most familiar to us, the world has been in a state of continuous change—usually continuous increase. We have seen a few European immigrants into North America expand during a few centuries into a population of over 170,000,000. We have seen villages grow into large cities. We have seen an area of primeval forests and prairies transformed into widespread agricultural developments. We have seen a transition from a handicraft and agrarian culture to one of complex industrialization. In only a few generations we have witnessed the transition from human and animal power to electrical power supernetworks, from the horse and buggy to the airplane.

At the same time our senses have been dulled by the platitude that "history repeats itself."

As a consequence, we have become so inured to change, especially to growth and to increase, that it is difficult for us to conceive that such has not always been the case and that similar developments may not occur indefinitely. In fact, it is difficult for us not to regard the rates of change which we are now witnessing as the normal order of things.

In order the more properly to appraise where we now are and the limitations which may be imposed upon our future, it is well that we consider in historical perspective certain fundamental relationships which underlie all our activities. Of these the most general are the properties of matter and those of energy.

From such a point of view the earth may be regarded as a material system whose gain or loss of matter over the period of our interest is negligible. Into and out of this system, however, there occurs a continuous flux of energy in consequence of which the material constituents of the surface of the earth undergo continuous or intermittent circulation. These material constituents comprise the familiar chemical elements, only a few of which, occurring in but a few parts per million, are significantly radioactive.

For the present discussion we shall restrict our attention to the nonradioactive materials and shall summarily state that the events under consideration are the result of a flux and degradation of a supply of energy, and the corresponding circulation of matter regarded as consist-

ing of nontransmutable and indestructible chemical elements.

All but a minute fraction of the energy involved in this process is that derived from solar radiation, and a small part of the matter at or near the surface of the earth occurs in the peculiar aggregates known as living organisms. A part of the solar radiation incident upon the earth serves to propel a circulation of matter into and out of this organic assemblage, and in the process an amount of energy roughly proportional to the mass of the matter incorporated into organisms is held in storage as chemical potential energy.

From geological evidence, organisms have existed upon the earth for probably as long as a billion years. during the last 500,000,000 of which a fraction of these organisms have become buried in the accumulations of sediments under conditions which have prevented complete disintegration and complete loss of their energy content. Consequently, there exist in the sedimentary rocks of the earth today accumulations of the remains of fossil organisms in the form of coal, oil shale, and petroleum and natural gas, which are rich in fossil energy stored up from the sunshine of the past 500,000,000 years.

This process of accumulation is doubtless still occurring, but the rate is probably not very different from that of the past, so that, for an order of magnitude, the accumulation during the next million years will probably not exceed 1/500th of the accumulation which has occurred already.

With this background let us consider the development of the human species. From archeological and geological evidence it appears that evolution had proceeded far enough that a species recognizable as *man* must have existed roughly a million years ago. The population of this species at that stage is unknown, but evidently was not large. It existed in some sort of ecological adjustment with the rest of the organic complex and competed with the other members of the complex for a share of solar energy essential to its existence. At that hypothetical stage its sole capacity for the utilization of energy consisted in the food it was able to eat—the order of 2,000 kilogram-calories per capita per day.

Between that stage and the dawn of recorded history, in its achievements this species is distinguished from all others by its inventiveness of means for the conquest of a larger and larger fraction of the availamle energy. The invention of clothing, the use of weapons, the control of fire, the domestication of animals and plants, and many other similar developments all had this in common: *they increased the fraction of solar energy available to the use of the human species, and they continuously upset the ecologic balance in favor of an increase in numbers of the human species,* with corresponding adjustments in all the other populations of the complex of which the human species was a member.

From that early beginning until the present day this progression has continued at an accelerated rate. It involved the development of wind power and water power, the smelting of metals with wood as fuel, the extensive employment of beasts of burden. However, throughout this period until the last few centuries the *rate* of these changes was sufficiently small that population growth was able to keep pace. The energy consumed per capita, therefore, increased but slightly. (Complete paper to be published in *Science.*)

THE UPPER ATMOSPHERE

The Sun and the Earth

Donald H. Menzel
Harvard University

Recognition of the fact that the sun has a direct influence upon the earth antedates human history. The division of time into day and night and the partition of the year into seasons depend upon the relative aspects of earth and sun. The squirrel who stores nuts for the winter instinctively appreciates the effect that the changing position of the sun has upon the weather. Our primitive ancestors resorted to sun worship and to sacrifices in an attempt to control or influence a power of such obvious importance.

We cannot now reconstruct the primitive arguments evoked by our ancestors in favor of sun worship. In all probability the obvious fact that one summer may differ exceedingly from the previous or following summer may have had something to do with the development of solar religions. For, if the character of seasons recurred as regularly as the sequences of day and night, the ancients would have had no basis for assuming that they could influence the weather by religious rites.

Even today, we are still unable to answer the question why one summer may bring rain and a bountiful crop and the next only a killing drought. The position of the sun has repeated with geometrical exactness. Are the intrinsic variations of the sun, of which the well-known sunspot cycle is an example, responsible for the differences? Or is the earth's atmospheric circulation so extremely complex that the solar influence, however variable, is only a minor complication?

Until recently, most meteorologists have been inclined to accept the second proposal as true. However, here and there various meteorological phenomena have shown periodicities suggestive of the 11-year sunspot cycle. And Haurwitz has shown that temperature changes within the ozone layer may produce large-scale motions of air masses at lower levels. The theory is far from complete, but it does suggest that the clue to long-range weather forecasting may lie in the upper atmosphere and, more particularly, in phenomena controlled by changes in solar radiation.

Certainly, it is in the upper atmosphere that we find the most evident effects of solar variability. In the ionosphere—the layers of electricity that reflect radio waves to great distances around the earth—we find two marked effects of changes of quantity of solar radiation with the sunspot cycle. The number of electrons in the various ionospheric layers is greatest when spots are most numerous. The study indicates that the ultraviolet radiation responsible for the electrification of layers increases by a factor of about 16 from sunspot minimum to maximum.

In addition to the rise and fall of ionization with

the sunspot cycle, the ionosphere is subject to disturbances that are also associated with solar activity. There are the so-called "sudden ionospheric disturbances," which occur simultaneously with a burst of ionizing radiation from the sun. Some region of the solar atmosphere, most commonly in the neighborhood of a large, active sunspot, becomes extremely bright and hot. We observe a brilliant flare in light of hydrogen. The radiations from the flare apparently penetrate to the lowest ionospheric levels, where they increase the electrification. Short-wave radio signals are strongly absorbed in this region of atmosphere and may completely "fade out" for a period of minutes or hours, until the solar flare dies away.

The second type of disturbance has its greatest effect in the upper levels of the ionosphere. The electrified region pulsates, and the amount of electrification usually decreases. Brilliant aurorae and intense magnetic storms (fluctuations of the compass needle) often accompany the ionospheric disturbances.

We still do not have any really satisfactory theory of ionospheric storms of this type. Most of us believe that the earth has encountered a large cloud of electrons and ions, ejected by the sun. Although we photograph the sun daily and often see explosions, there is little definite evidence that the moving material actually leaves the sun. The streamers of the solar corona are, perhaps, the best evidence for the existence of ejected matter.

We are now in a scientific period where intensive study of the sun, together with simultaneous study of many types of terrestrial phenomena, should lead to discoveries of vital interest and practical value. And, in our search for clues related to weather causes, we should remember that our present climate—variable as it is—has not been representative throughout geological history. The earth has undergone a number of separate and distinct periods of glaciation, with interim periods when the climate was appreciably warmer than at present. Magnolia trees once flourished in Greenland, for example.

Within the past million years the earth has experienced four separate periods of glaciation. None of the various possible causes proposed to account for the onset of the ice ages appears to be adequate. There is good reason to believe that the glaciation occurred simultaneously on all continents and probably in both hemispheres.

Geologists and meteorologists have hesitated to ascribe the variability of terrestrial climate to a solar cause. But many have gradually come to the conclusion that a solar origin is the only remaining acceptable hypothesis. A million years is only a small amount of time in terms of the age of the sun or earth. Any variations in the output of solar heat cannot be attributed to evolution. But we cannot disprove, at the present time, the suggestion that the sun may have a long-range variability in addition to its 11-year cycle.

However, there is one other possibility to consider—a possibility that has not been previously suggested, to my knowledge. There are, in space, many extended objects known as dark nebulae, clouds of dust that obscure the light of the stars behind or inside them. In the course of geological time our sun has probably passed through many such nebulae.

A dark nebula is so tenuous that the materials between the earth and sun would exert a negligible effect on the amount of heat and light reaching us. But an extensive cloud—even if partially transparent—could scatter an appreciable amount of radiation back to the earth. At the first sign, one might conclude that the excess radiation would produce an effect just the opposite to that of an ice age. However, a cold age is not necessarily an ice age. Accumulation of ice and snow requires both high evaporation of water from the oceans and high transport of the moisture-laden air to the poles.

If the sun has been traversing a dark nebula, from which it emerged only some 50,000 years ago, the denser portions of the nebula might give the warm interglacial periods and the less dense regions the eras of ice accumulation. If this theory is correct, the outer fringes of the nebula are only about one parsec away (a parsec is about 20 million million miles, or 4 light years), in the direction of the constellation Columba. Since the nebula as a whole may be very thin, compared with the average dark nebulae, its effect on the light of more distant stars will be negligible. This hypothesis is far from proved, but it suggests a new approach to the old problem of the glacial periods.

Cosmic Rays in the Stratosphere

Marcel Schein
University of Chicago

It is known to physicists that a radiation consisting of charged particles enters the earth's atmosphere from the outside. This so-called "cosmic radiation" has a flux of about 0.12 particles/cm²/sec/unit solid angle at a geomagnetic latitude of 50° N. Of what possible interest can a radiation of such extremely weak intensity be to scientists? We must be very clear about this point, since physicists are now concentrating a great effort on exploring the exact nature of cosmic-ray phenomena. That we are dealing here with a radiation of very extraordinary nature is given by the fact that each individual particle in the cosmic radiation carries an energy much greater than anything which has been explored in nature. The average energy of a primary cosmic-ray particle is estimated to be close to 10 billion electron volts. It was found, however, that some of the individual cosmic-ray events correspond to energies as high as 10^{16} electron volts (10 million billion electron volts). It is then obvious that in the field of cosmic radiation there arises the fundamental problem of whether or not the basic laws of physics which were proved to be valid for lower energies still hold for these extremely high energies. This applies, in particular, to the problem of the nature and properties of our fundamental particles, which could not be studied in sufficient detail in the domain of low energies. It is also expected that a thorough study of high-energy nuclear phenomena will lead to a deeper understanding of the short-range forces holding the atomic nucleus together. As a matter of fact, at the present time we find ourselves in a very confused situation with respect to these fundamental problems. This might be somewhat

surprising in view of the fact that great progress has been achieved in the general understanding of microscopic phenomena with the aid of electromagnetic and quantum theories. However, the knowledge gained from low-energy processes seems definitely insufficient. Two facts demonstrate this is a striking way:

(1) The occurrence of new fundamental particles like the μ-mesotron, the π-mesotron, and the neutral mesotron. (A mesotron of mass around 700 electron masses is also eventually present in the cosmic radiation.)

(2) The discovery of new fundamental interactions between elementary particles like the creation of a mesotron, its nuclear capture, etc.

At present there are two possible ways to penetrate into the field of very high energies: (a) by using the natural source of high-energy particles in the cosmic radiation, and (b) by using artificial sources (accelerators). Method (b) has the great advantage over (a) that, by using accelerators, one can investigate high-energy phenomena under controlled conditions. On the other hand, (a) is superior to (b) in the direction that, in the cosmic radiation, individual particles of such high energy can be found that even the most ambitious construction program of accelerators cannot compete with nature on this score. Therefore, gaining further knowledge of cosmic-ray phenomena seems vital to physics.

Cosmic-ray studies in the high atmosphere are of particular interest since the collisions of primary particles with atomic nuclei of air are relatively frequent events at these altitudes. This process gives us the possibility of investigating nuclear interactions at particle energies of several billion electron volts. The experimental results indicate that we are dealing here with one of the most interesting new processes in nature. Under the action of a primary the nucleus explodes into a number of fragments, and, in addition, new particles like mesotrons are created simultaneously. The nuclear fragments (protons, neutrons, plus other nuclear particles) and the mesotrons are projected into the atmosphere with considerable speed. According to recent experiments of Bridge, Rossi, Fretter, and others, electronic radiation is also released in some cases in collisions of primaries with nuclei. The secondary particles represent, then, the bulk of the cosmic radiation at lower atitudes. On the average their energy is lower than that of the primaries. The important region of the atmosphere in which the conversion of most of the primaries into secondaries occurs lies between the top of the atmosphere and an altitude of 11 miles (roughly 1/10 of our atmosphere by weight). This is then, the region in which we can study best effects pertaining to primary cosmic rays.

Some of the interesting problems under attack are: (1) nature and origin of the primary cosmic radiation, (2) collisions between primaries and atomic nuclei, (3) properties of the various particles found in the cosmic radiation, (4) intensity of the various cosmic-ray components, (5) influence of the earth's magnetic field on the motion of cosmic-ray particles, (6) fluctuations in the cosmic-ray intensity, and (7) correlation between atmospheric changes and variations in the intensities of the various components.

At the present time many of the above-mentioned problems are still unsolved. We shall therefore limit ourselves here to giving a very brief description of some of the techniques used in cosmic-ray research in the stratosphere and then describe a few of the results that have been obtained.

Most of the cosmic-ray investigations in the stratosphere were carried out with the aid of Geiger-Müller counters and ionization chambers. Anderson and his collaborators used cloud chambers in a B-29 plane. Cloud-chamber pictures were also obtained in balloons by Anderson's group and by the cosmic-ray group at Minnesota. The technique of tracks in photographic emulsions was frequently used during the past year.

The above-described instruments were carried into the stratosphere by V-2 rockets, balloons, or airplanes. Rockets reach altitudes of about 100 miles, balloons about 100,000′, and B-29 planes about 40,000′.

A number of slides illustrate important features of experimental techniques used in the stratosphere.

The following points are discussed: (1) What is the nature of the primary cosmic radiation? (2) What are the main cosmic-ray components in the stratosphere? (3) What are the essential interactions between cosmic-ray particles in the high atmosphere?

The various cosmic-ray components and nuclear explosions and mesotron tracks recently obtained in the stratosphere are shown by diagrams and pictures.

The Circulation of the Upper Troposphere and Lower Stratosphere

C. G. Rossby and H. C. Willett
University of Chicago and Massachusetts Institute of Technology

The great increase of observational data from the upper troposphere and lower stratosphere, obtained in recent years by radiometeorograph and radar, has extended and somewhat modified the accepted picture of the circulation of the earth's atmosphere in the higher elevations. In particular the jet-stream characteristics of the circumpolar vortex, *i.e.* the west-wind belt of middle latitudes in the upper troposphere, are difficult to reconcile with earlier conceptions of the operation of the general circulation. This jet maximum of the westerlies near the tropopause in middle latitudes normally exceeds a velocity of 100 miles/hr in winter and occasionally reaches nearly twice that speed.

By emphasizing the principle of the conservation of absolute vorticity, rather than the conservation of angular momentum, in the lateral mixing processes in a gaseous envelope such as the atmosphere, Rossby has been able to offer a plausible explanation of the jet-stream characteristics of the circumpolar vortex in the vicinity of the tropopause. This same principle appears to explain also the zonal distribution of rotational velocity in the solar atmosphere, and phenomena such as the observed equatorial "accelerations" on the planets Jupi-

ter and Saturn. On the basis of the latitudinal transport, by lateral mixing, of absolute vorticity and heat, combined with the gradual re-establishment by radiational processes of the latitudinal thermal contrast, Rossby can offer a hypothetical explanation of the large-scale irregular fluctuations of the general circulation.

The principal difficulty with Rossby's explanation of the operation of the general circulation lies in the fact that it requires, in the mean, an effective equatorward transport of angular momentum in the upper troposphere at all latitudes. It is difficult to reconcile this requirement with the observed distribution of east winds at sea level between the polar and the subtropical latitudes, and with the observed latitudinal transport of angular momentum in the middle troposphere. There exists also the possibility that irregular direct solar influences are partly responsible for the erratic character of the major irregular fluctuations of the general circulation. (Complete paper to be published in *Science*.)

WORLD HEALTH PROBLEMS

The Global Concept of Disease

Ernest Carroll Faust
Tulane University

Disease results from the destructive action of pathogenic microorganisms, malnutrition, the dysfunction of organs, abnormal tissue growth, poisons, and the process of aging. Because of climate and its effect on the human body, many diseases are more prevalent in humid tropical countries, but malnutrition and the common communicable diseases are world-wide in their distribution. Dissemination of disease has been greatly increased by wars, pilgrimages, migration of peoples, and the need for more productive land for congested populations.

During the past century the causes of disease and the methods whereby diseases are contracted have been elucidated, and with this knowledge many disease entities have been brought under control in certain countries. Yet disease is global in its extent, and control measures must be conceived and carried out on a global scale. This must be under the direction of a single coordinating agency, the World Health Organization.

Influence of Modern Developments in Nuclear Energy Upon Public Health Problems

Stafford L. Warren
University of California at Los Angeles

The atomic bomb project and the attendant research in various fields of nuclear energy have had a tremendous impact on public health problems in both the general and the strict usage of the term "public health." This research has resulted in opportunities to learn about aspects of biology and medicine hitherto beyond the reach of research methods. It has introduced the possibility of contamination of air, water, and food on an industrial and public scale never before imagined. Thus, a new profession, that of the health physicist, or radiological safety monitor, has been created. It presents a new threat to mental public health in the fear of war, for we as a nation are perhaps more vulnerable than any other nation to the destruction and contamination an atomic war would bring upon us.

Certain direct benefits to the public health field from the nuclear energy war program can be easily recognized. Some of these are unique, and some are matched by research contributions from other war projects.

(1) The medical-biology program of the Manhattan Project had a definite goal and a deadline to meet, and it received unlimited support. It has demonstrated that large-scale medical and biological research can be carried out by teams and that good progress can be made in studying basic problems while conducting at the same time what may be called applied research or programmatic research. In fact, each type of research in the Manhattan Project complemented and enhanced the other. The achievements in basic science of these teams of researchers, working under pressure toward a specific goal, suggest that sterility of ideas in research is definitely a symptom of starvation and frustration of opportunity rather than of lack of capacity. I believe this to be one of the most important contributions of the war in medicine, because the application of these same broad principles of continued optimum subsidy of group research could speed progress in medicine and biology now as never before. The principle of group programming and self-disciplining was well developed and is responsible in great part for the present trend to utilize the mechanism of institutional grants for research over a broad field in the place of grants to individual investigators in specific fields, such as cancer research, heart disease, etc.

(2) The health-safety program (industrial hygiene) of the Manhattan Project and the Atomic Energy Commission has defined and emphasized the importance and the role of similar organizations in industrial plants and has shown the need of better standards and of well-trained men. This health-safety program contributed heavily to the war effort by reducing absenteeism, morbidity, and the cost of compensation claims. The unparalleled record of protection from all types of injury in the Manhattan Project, and now continued under the AEC, emphasizes the value of intelligent cooperation between management, plant and laboratory personnel, and the health-safety group. New research data were and are utilized promptly to set the standards for safe working conditions and to furnish methods for detecting the earliest evidence of injury and for possible methods of treatment in case of accident or violations of the regulations. The practical value of a strong and vigorous industrial hygiene program in industry is thus well demonstrated and should gain acceptance in industry the country over.

(3) The public health and medical care programs in the isolated communities of the atomic project have demonstrated that good medical facilities and care pay off in dollars as well as in high morale and stability of

personnel and in low morbidity and mortality from the common diseases.

(4) Many of the isotope research techniques and equipment developed during the war were the outgrowth of small beginnings before the war. The improvements in the use of both stable and unstable radioactive isotopes, plus their ready availability from atomic energy sources, have opened up avenues in medical and biological research unreachable before the war. The equipment and accompanying facilities are expensive. These techniques are most effective when employed by a coordinated team of men from a variety of fields. The avenues thus opened to the imaginative researcher in universities, industrial research laboratories, etc. are almost limitless. By using carbon, hydrogen, oxygen, and nitrogen of various masses, the chemist is able to trace the realignment of various parts of the molecule in the process of formation of new substances from marked known substances. The biologist, the biochemist, the pathologist, physiologist, etc. can study the utilization of these marked substances in the body in every system and can study the dynamic changes in function, injury, repair, absorption, transport, excretion, etc. from every aspect of his interest. Such research cannot all be done at once. Tremendous strides in this direction, however, have taken place over the Nation and, in fact, in the rest of the world, for almost every university is either working with isotopes now or attempting to obtain the money, equipment, and men to do so. Not the least part of the product of this resurgence of research is the training of new and young men in these techniques.

Widespread use of radioactive tracers in metabolic and other studies over a period of years will require that the same safety and protective regulations that exist in the current AEC plants are carried out faithfully during peacetime. Otherwise, insidious contamination of sewers and, in terms of streams, water supplies and possibly food will eventually occur all over the country. It is mandatory that the safeguards required by the AEC be carried out meticulously in all such research in order to protect everyone. These safety techniques must become routine, and their cost should be included in the cost of the experimental program from the beginning and not as an afterthought when complications arise. The concentrating power of plants and other biological materials should not be overlooked in the case of certain long-lived radioactive isotopes that are normally used by them. Familiarity with the research and protective techniques removes the fear of the hazard, although the hazard still remains.

The greatest hazard of all lies in the use of atomic weapons in war. The knowledge that such a hazard might exist has been widely disseminated since the end of the last war; yet the complete picture of a full-scale atomic war is so devastating that few have given the problem the emphasis that it deserves. Some scientists and the population as a whole view the contingency through a haze of mingled optimism and fear. Many have developed a fear neurosis concerning it which clouds their thinking and acting. Some think that the danger is grossly overrated. This very combination of fear and the defensive reactions which fear arouses (both direct and indirect) may become a serious public health problem. Part of the difficulty lies in the time that must elapse for the proper education of the public in the technical problems which the people must face in order to protect themselves. Part lies in the unwillingness of the governments of the world to view modern war in its true light. Fire bombing, although it takes planes and men in huge numbers, is one of the most effective large-scale destructive agents so far devised, but, aside from large-scale destruction and death, as bad as they are, there is no other aftermath. With the other major destructive agent, the atomic bomb, the same destruction, fire, and death are achieved more uniformly, and, when properly applied, a fantastically widespread contamination with radioactive materials can be left behind that will defy all public health measures for complete protection for a long time, measured in years, even decades. Such a circumstance would create the greatest public health problem of all time. Since at least two nations would be involved, contamination hazards to health would extend into large areas of the globe. As educators, we all know that our people and our Nation do not wish such a thing to happen. The solution of this health problem unfortunately does not lie within our province alone. Whether the die is ever cast depends upon the willingness of all nations to agree to permanent peace. The best antidote for fear is a well-defined, intelligent course of action. Therefore, public health authorities, educators, and the new Office of Civil Defense have a direct responsibility to the public to: (1) spread accurate, readily understood facts and knowledge about the nature of atomic war, (2) plan specific programs for public protection, (3) train radioactive safety crews for public protection, and (4) give the public specific information for its own protection in case of widespread contamination and general information on catastrophe from any cause. In any situation it is the informed and trained individual who has the best chance of protecting himself.

Medicine and Public Health in the International Scene

Leonard A. Scheele
U. S. Public Health Service

EDUCABILITY

Educability and the Schools

Ralph W. Tyler
University of Chicago

Educability is conceived as potential capacity to succeed in the present school system, with its present ends and means. So conceived, it can be measured, and success in school can be predicted with fair precision.

Prediction based on this concept of educability is, however, unsatisfactory, for the reason that present educational ends and means are inadequate. Reliance upon

m results in denial of educational opportunity to those o need it most.

We need a broader concept of educability as potential pacity for socially or personally valuable behavior. ucational research should identify and measure those tential capacities that may be developed by the schools d that are indices of success in all walks of life. velopment of these capacities should become the end of ucation. Educational research should also investigate rning in all aspects of human experience so that edutional means may be improved.

The Growth Potentials of the Human Infant

Arnold Gesell
Yale University

All educability is dependent upon innate capacities growth. The child inherits these capacities from imediate and remote ancestors. Every child has a unique ttern of growth which is the basis of his individualy and of his ability to profit by experience. Growth n be guided, but it cannot be imparted by environent or education. The child's growth potentials are rt of his constitution, and he is fortunate if he is rn with a favorable equipment of genes, because he ust do his own growing. The culture with the aid of ience can give the child wise assistance if it underands and takes heed of his ways of growth.

These are the conclusions of systematic investigations ade at the Clinic of Child Development, School of edicine, Yale University. The speaker demonstrated e nature of these investigations by means of a sound m which depicted the stages of natural growth in the tterning of infant behavior. Utilizing motion-picture meras, the Yale Clinic has documented thousands of ehavior patterns at 34 progressive age levels from rth through the first 10 years of life. Cinema and enographic records were carefully analyzed to chart e progressions of growth in the four major fields of ehavior—motor, language, adaptive, and personal-social.

These studies show that the mind of the infant is a omplex action system which matures in a lawful stepy-step manner in all fields of behavior—in the coordiation of eyes and hands; in creeping, standing, walkg; in language, imitation, and social communication; emotional expression; in his fears, affections, and uriosities; his attitudes toward mother, father, and playates; his judgments of right and wrong; his sense of umor; and even in his ideas about life, death, and naure. The orderliness of the growth process is evidenced the sequences of block-building: at 4 weeks the infant ooks at a 1″ block; at 24 weeks he picks it up not only ith his eyes but also with his hands; at 28 weeks he angs with blocks; at 18 months he builds a tower of hree blocks; at 2 years, a wall; at 3 years, a bridge.

Such a sequence may be called a law of nature. imilar sequences prevail in all fields of psychological rowth, including personality as well as intelligence.

The mechanisms of human growth are culminating end roducts of ages of evolution. The race evolved; the child grows. Each and every part of the child's makeup has to grow—bones, brains, and behavior. The laws of growth are as ubiquitous and pervasive as the laws of gravitation or of atomic energy.

The child's abilities and his educabilities are governed by the underlying maturity of his behavior patterns. The forms and lawful sequences of growing behavior patterns can be defined by the life sciences, including a clinical science of child development. More knowledge needs to be applied at the beginnings of the life cycle to reduce the mounting tide of adolescent instability and of adult abnormalities of behavior. Through broadened methods of developmental diagnosis and supervision in infancy, through individualized growth guidance in nursery and elementary schools, we can strengthen the stamina of the child and of the family unit. We can discover distinctive gifts and talents in the early years of life. We should place more stress upon the positive and constructive expressions of child development, particularly in the first 5 years of life, which are basic for all later development. The intrinsic badness of children has, in my opinion, been vastly exaggerated by distorting interpretations. Well-constituted children with healthy inheritance have an intrinsic charm—a charm which betokens intrinsic goodness. The growth potentials for good exceed those for evil, unless the cultural odds are too heavily weighted against the child. (Full paper to be published in *The Scientific Monthly.*)

The Social Environment of the Educational Process

Talcott Parsons
Harvard University

The problem. Biological plasticity provides the opportunity for all human educability. But man is a social animal in a special sense. His interdependence with others in the social system on the one hand limits the biologically possible range and on the other lays the foundations of specifically human educability—e.g. language and emotional capacities.

The case of German re-education. Widespread ideas of re-educating the German people for democracy by removing Fascist or Nazi influences from textbooks, press, and radio and substituting democratic ideas illustrate neglect of dependence of education on the social system. So far as German nationalism was a product of the special German society, susceptibility to it cannot be removed without far-reaching social changes. If these do not take place, there is a serious danger of intensifying this susceptibility rather than the reverse—the "boomerang effect."

Approach to the sociological analysis of educability. Social systems are now known to operate not only by deliberate rational action of their members but, underlying this, by an intricate system of automatic and semiautomatic adjustment processes—analogous to the biological. For this to be possible, people must be very specifically adjusted to the needs of the particular so-

ciety. This is only conceivable if education or "socialization" in the broadest sense is thought of as an integral part of the functioning of the society itself as a system. This is true on all levels, but pre-eminently that of the subtler elements of personality structure adapted to the needs of a particular society.

The relevant aspects of social systems. Social systems consist of interacting behaviors of people. These, however, are crystallized in relatively stable patterns—in structural terms, institutions. In terms of behavior of individuals institutional patterns define roles—expectations which the incumbent of a given status must fulfill. Psychologically, the role system makes it possible to mobilize all principal elements of motivation (in the integrated case) in the service of behavior which will promote the functioning of the larger social system.

The system of institutionalized roles is relevant to educability in two senses. First, the process of education sociologically considered is essentially the processes of establishing the integrations of motivation appropriate to the various roles of the social system. Second, the role system itself provides a crucial component of the mechanisms by which these integrations are brought about.

The components of such an integration of motivation may be said to rest on three interdependent levels. First is what has sometimes been called basic personality structure—the fundamental attitude tendencies of the personality with respect to authority or submissiveness, to active achievement or withdrawal, to accepting or evading responsibility, to openness to affective contact with others or emotional withdrawal. Second is the symbolic definitions of situations and goal systems of the society, the orientations toward achievement and success, toward proper relations toward the opposite sex. In one aspect this is what is generally referred to as "ideals." Third is the level of specific knowledge and skills of the types ordinarily taught on "academic subjects." On a common-sense level, the last are by far the most susceptible to deliberate rational control. The others have proceeded mainly by automatic process but are subject to some control if the forces operating are scientifically understood.

Education as a process within the social system. Broadly, the last of the above levels is that of education imparted by deliberate teaching, the first by informal processes, the middle by a mixture. The "deeper" levels are laid down in the process of social interaction with emotionally significant persons. Three primary roles of great educative significance in our society should be distinguished: those of parent, of peer group member, and of teacher.

All operate by unconscious processes. The parental role combines establishment of disciplines with emotional support necessary for assimilation of discipline. Beyond a certain point there is danger of fixation unless emancipation occurs. The parents are the earliest role models. The peer group is the primary field of free experimentation with social role skills. It is of particularly crucial significance in American democracy. The teacher is more impersonal and "universalistic" than the parent. The role is crucial in mediating emotional transition to participation in the wider society. In America special problems are raised by the role of the woman teacher as a role model, especially for boys.

The role of teacher has analogies to that of physician. Precisely by being outside the more intensive emotional interactions of the family is it possible to help the child in making his emotional emancipation. This emotional emancipation underlies the pupil's capacity to be taught specific subject matter.

Education and social control. The educational system of a society is indeed deeply rooted in the whole social system. It is not, therefore, unchangeable. It is, moreover, a most strategic point from which to modify the system. But this can be done successfully only if one uses the total balance of social forces in the social system as they infringe on the educational structures. The American faith in education is not misplaced. But it needs to be implemented with a maximum of scientific sophistication. One must work in and through the social system, not against it.

SCIENCES OF SOCIETY

Sociology

Samuel A. Stouffer
Harvard University

Is Economics Necessary?

Kenneth E. Boulding
Iowa State College

Being an economist, I can hardly be expected to answer "No" to the above question. I intend to examine briefly the type of contribution which economic theory makes to science in general and to the social sciences in particular.

Economics has the not-undeserved reputation of being one of the most "successful" of the social sciences, in that it has produced a considerable body of propositions that are widely accepted by competent persons. Nevertheless, there has been something of a smoldering revolt against its methods, especially by students of economic institutions. Some of this is due to misunderstanding, some to emotional biases, but there is a residue of justice in it.

The method of economics is that of a logicomathematical analysis of the necessary relationships of certain selected quantities, such as wages, prices, outputs, etc., on the assumption of certain functional relationships between them and of certain principles of selection among alternative opportunities. As a system of analysis it gives us—like any mathematical science—simply a system of hypothetical propositions: if A, then B. Whether A or B is true or false is a matter for empirical inquiry. Nevertheless, no economist is quite "pure": his "models" are inevitably biased in favor of the world as he sees it, just as elementary geometry is biased in favor of Euclidian space. In the endeavor to explain the

lationships of so-called "economic" variables, however, economist has been gradually forced into a much re general theory, so that now economics has become entially the general theory of choice, *i.e.* of the imcations of "scarcity." As such, the conclusions of nomics not only are relevant in the small sphere of solled "economic institutions" (money, banking, firms, .) but apply wherever choice is necessary, which ans that they apply almost universally—to art, music, vernment, and even to theology. Moreover, in developg a pure theory of choice, economics has been forced by case of oligopoly to develop a theory of strategy ere the choices of several individuals are reciprocally pendent.

Economics has also made an important contribution to ientific method in that it has been forced to develop chniques for handling complex general equilibria. ese are found in many sciences—e.g. general planetary uilibria in astronomy, ecological equilibria in biology, d so on. The problem is of overwhelming importance economics, however, and three approaches have been veloped toward it: the *cereris paribus* approach of arshall, the simultaneous equations method of Walras, d the macroeconomic methods of Keynes. Of these, e third seems to be at once the most dangerous and e most fruitful; in it the system is considered as a hole in terms of a few aggregates. The method should applicable in many other sciences.

Finally, economics is necessary because of the great actical importance of the universe it investigates. The rvival of our civilization depends perhaps on the anver to an intellectual problem: whether Marx was right out the self-contradictory nature of capitalism. Even re than the solutions it may yield, however, economics necessary for the state of mind it produces: in a day en self-interest, statism, militarism, and a dreadful ide threaten our very existence, economics inclines ward the general interest, points out that this is not compatible with individualism, urges that trust is the urce of power, and by its very failures induces that mility without which we shall all be destroyed.

"It is not an exaggeration to say that, at the present y, one of the main dangers to civilization arises from e inability of minds trained in the natural sciences to ceive the difference between the economic and the chnical" (L. Robbins).

Have Civilizations a Life History?

Alfred L. Kroeber
University of California

How far may we justifiably separate or distinguish vilizations; and how far are these separate civilizations, vertheless, repetitive, recurrent, and similar in type d in their life histories?

Most major civilizations are supernational. A major vilization is normally multinational and multilingual, ough it may possess one standard language. Each civiation has a fundamental ideology, a coordination of cultural patterns, a master pattern. The process of cultural growth from shadowy, groping beginnings, through selective commitment, to particular forms or patterns, and growing control of these until they are achieved and their potentialities are realized—this process seems to be basic in the history of civilizations.

A corollary of the foregoing findings concerns genius. Great men notoriously cluster in time and place. The pattern and master-pattern interpretation of civilization explains this clustering. Great men can appear only while great patterns are in the shaping during the life history of a civilization. At other times native genius is wasted—it has nothing to take hold of, it leaves no achievement that permanently means something. It must be civilization that is the cause of the fact that the overwhelming majority of the men whom we unanimously recognize as great have lived in the great periods of great civilizations. (Not abstracted by author.)

PROBLEMS OF THE OCEAN

Biological Problems of the Ocean

Daniel Merriman
Bingham Oceanographic Laboratory

An Analysis of the Stirring and Mixing Processes

Carl Eckart
Scripps Institution of Oceanography

The terms "theoretical" and "empirical" are both often used in a derogatory sense. Especially in the first enthusiastic rush of discoveries in a new field, theory is apt to be frowned upon as bearing no relation to fact. This has some justice, because usually the true theory of the processes has not yet been developed.

One pair of related processes whose theory has scarcely been studied are those of stirring and mixing. In the laboratory, the mixing of two liquids in a beaker with the aid of a stirring rod is such a commonplace operation that its theoretical analysis seems unnecessary. In the ocean, the intermingling of water masses is one of the most basic phenomena and deserving of the most careful theoretical analysis.

The transfer of heat from one part of a solid to another occurs solely by molecular conduction. In the case of a liquid mass, transfer of heat can also be brought about by the actual motion of one part of the mass relative to another. This is clearly exemplified by stirring a stratified mass of water. Empirically, stirring is found to hasten the disappearance of temperature differences.

Theoretical analysis confirms this observation and gives a detailed account of the mechanism by which this is accomplished. The relative motion caused by stirring brings warm and cold masses of liquid into closer juxtaposition, but does not alter the temperature difference existing between a given pair of masses. It does, however, increase the temperature gradient or space-rate of change of temperature. Since the molecular con-

duction of heat is proportional to the temperature gradient, stirring increases the molecular conduction.

The effect of conduction is to decrease any existing temperature differences. In the case of liquids, this molecular process is properly called mixing. Stirring, so to speak, sets the stage for mixing. After a preparatory phase, whose duration is calculable in simple cases, the mixing process becomes so rapid that it is dominant.

Calculation indicates that, in stirring warm water into a beaker of cold water, the time required for the mixing process to begin is of the order of seconds. In the ocean, it may be of the order of days or even years. But the ocean has been in existence for much longer than this, and the wind has been stirring it throughout that time. Consequently, contrary to opinions sometimes loosely phrased, the molecular processes predicted by theory must be occurring in the ocean and influencing its behavior. In fact, if the ocean is really in a state of dynamic equilibrium, these molecular processes must determine that state. (The full article on which this abstract is based will be published by the *Journal of Marine Research* under the title "An Analysis of the Stirring and Mixing Processes in Incompressible Fluids.")

Oceanography and the Oceans

R. H. Fleming
U. S. Navy Hydrographic Office

One hundred years ago the waters beneath the ocean surface were virtually unknown. Scientists had been preoccupied with unraveling the many mysteries of the land. Furthermore, the study of the depths of the great ocean basins and life and the conditions in them had to wait until means were devised to lower and raise heavy instruments. The sailing ships of a hundred years ago had only the strong arms and backs of the crew to operate hoisting gear, and it was not until steam power was available on ships to operate their winches that the science of oceanography could flourish.

A century ago our ideas about the oceans were based on scanty and often incorrect information that led to many misconceptions. It was believed that the deep waters were barren of life and that the depths were fantastically great. The great era of oceanographic exploration was the last half of the 19th Century. Refined and rapid methods of investigation, developed in the last generation, have given us a general understanding of the seas, but there are many regions yet unexplored and many problems that have barely been recognized and for which we still lack adequate theories.

The future of oceanography lies in carefully coordinated programs involving work at sea, laboratory studies, and theoretical investigations. The observational program must guide the theorist in his work, and the latter must assist by indicating the kinds of observations and equipment that will lead to the most valuable results. The oceans form the largest single feature on the surface of the earth. The scientists of the future must give to the study of the seas the attention they merit.

FOOD AND NUTRITION

Seven Decades of Nutrition Research

C. A. Elvehjem
University of Wisconsin

The important advances in nutrition during each of the 7 decades between 1880 and 1948 are reviewed. The period from 1900 to 1910 is characterized by a growing interest in biochemistry. The period between 1920 and 1930 is described as a transition stage between the early unstandardized animal studies and the more effective approach resulting from a greater chemical interest. The decade from 1930 to 1940 will undoubtedly be recognized as a period in history when greatest progress was made in the chemistry of essential nutrients. All the work emphasizes the importance of recognizing the nutrients taken in by the living cell, whether they be present in animals, plants, or microorganisms.

Enthusiasm over newly-discovered nutrients may have given too great emphasis to certain phases of nutrition for short periods of time, but active workers soon reinstituted the proper balance. Workers in nutrition have made use of the scientific advances in many of the related fields and at the same time have contributed to the advances in allied fields; but, in doing so, they have not diverged too far from the main goal of optimum health for all.

Cultural Contexts of Nutritional Patterns

Margaret Mead
American Museum of Natural History

In all known human societies dietary patterns are learned. Man must depend not on any instinctive equipment which guides him surely to the right foods, but upon learning as a child a form of behavior toward food that will assure him adequate nutrition. By the way in which we reward a child with one food, reward a child for eating another food, pull him away in disgust from an attempt to eat some food which is said to be only food for dogs or cattle or members of another social group, we build up a set of attitudes which enables the individual to thread his way among available foods. In primitive societies and among peoples whose diet is very meager and in which some nutrients have only minimal representation, rigid food habits have been necessary, because if the people did not adhere to a rigid pattern of including all the proper foods, they could not survive. In today's world, with modern transportation and processing, foods are available in such great variety that mankind now faces the need to learn how to be flexible and yet choose a good diet.

Future dietary patterns, in which we make full use of nutritional research, of natural resources, and of our knowledge of individual psychology and of the cultural behavior of human groups, may result in tapping possible human capacities to make individual food choices that will be superior to the fixed traditional dietary patterns of

the past. However, the most pressing problem in nutritional change today is to guard individuals and groups in periods of transition from the health hazards which accompany changes from an old traditional diet to new and partially understood or incompletely adopted dietary habits.

Nutrition and the Climatic Pattern of Soil Development

Wm. A. Albrecht
University of Missouri

Our westward march to the mid-continent with its extensive areas of deep and fertile soils built American prosperity and our many freedoms. Those soil resources gave individual security and thereby independence. They gave birth to the political philosophies concerning the rights of the individual in the national group. They are now being tested for their guarantee of the rights of that group in the future family of nations when problems of food and nutrition under exhaustion of soils and multiplying populations are pressing westward on a global scale.

The nomad found his good nutrition when his cow went ahead of his plow. His herds were biochemists assaying and selecting the soil as guarantee of their growth and reproduction via proper nourishment. They were not measuring its production as tons and bushels per acre under economic pressures. Their nomad owner plowed it with assurance of its delivery of the requisites for his good nutrition. But modern technological means put the plow ahead of the cow. They pushed agriculture away from more fertile soils under animal selection and into the fringes of fertility. There single crop specialization flourishes under hidden hazards for, and deficiencies in, nutrition.

The climatic pattern of soil development of the United States emphasizes the fertility of the mid-continent for protein production and nutrition of high order. This was once buffalo territory, and later the hard wheat and beef cattle area. Less rainfall and insufficient soil development to the West limit production in balanced nutrition. More rainfall and excessive development of the soil to the East represent greater nutritional problems in its delivery of mainly carbohydrates under the criterion of, and economic emphasis on, bulk. Basic to this varied food synthesis by the plants is the pattern of the chemical fertility of the soil.

Our national pattern of this delineates the ecology of the soil microbes, of the native and crop plants, of the wildlife, of the domestic animals, and of man himself. We have been late in seeing ourselves and other life according to the variation in nutrition determined by the fertility pattern of the soil. Geographic arrangements of draftee rejections, of tooth troubles, and of diseases more generally have not yet been viewed as the possible result of nutritional deficiencies going back to the soil. Whether we can see a world pattern of control by the soil seems to await the day when not only deficiencies in nutrition but hunger in terms of failing bulk compel us to recognize that the soil is in control.

WAVES AND RHYTHMS

Rhythmic Behavior of the Nervous System

Hudson Hoagland
Worcester Foundation for Experimental Biology

This paper first briefly reviews certain established facts about the nature of nerve messages and of electrical brain waves and considers these waves and rhythms in contrast to other forms of rhythmic events. The paper then goes on to discuss recent developments of electronic calculating machines which shed suggestive light on considerations of higher brain mechanisms. Work in particular of Wiener, Rosenblueth, Adrian, McCulloch, Pitts, and Northrop is reviewed in interpreting the possible role of brain waves in perception and in memory and the philosophical implications of these approaches.

The paper reports no new experimental findings. It is rather an attempt at synthesis of several fields of interest.

Ground Waves and Air Waves

James B. Macelwane, S.J.
St. Louis University

Sound Waves and Rhythms

Vern O. Knudsen
University of California at Los Angeles

A summary of the rhythmic patterns of sound waves in music, speech, and noise is given. The historical background of these ever-present acoustical phenomena is considered, starting with the Chinese, Egyptians, and Hindus and continuing with the controversial views of Pythagoras and Aristoxenus. The modern science of sound started with Galileo, who first deduced the laws of vibrating strings. The first application of geometrical acoustics to theaters was made by Kircher in 1650.

The epochal advances in the 19th Century call to mind the great contributors Biot, Fourier, Savart, Ohm, Henry, Tyndall, Stokes, Kirchhoff, Lissajous, and Helmholtz, and the monumental work of Rayleigh.

Mention is made of the great low-frequency disturbances produced in the atmosphere by the eruption of Krakatoa in 1883 and the Siberian meteor of 1908. This is followed with a more detailed account of waves of small amplitude. The dependence of the attenuation of such sound waves on temperature, humidity, viscosity, and heat conductivity, and contamination of the atmosphere are noted. A brief review is given of the effect of molecular collisions and fog on the transmission of audio-frequencies.

The paper concludes with a review of the rhythms of sound waves in enclosures. The theories of geometrical and wave approaches to the description of sound in interiors is reviewed in some detail, and the author's compromise solution for determining the acoustical properties of enclosures is presented. (The complete paper on which this abstract is based will be published in *The Scientific Monthly*, 1948, 67, 430.)

One World of Stars

Harlow Shapley
Harvard College Observatory

Governments and astronomical observatories have long been associated. The ancient Egyptians, Babylonians, and Chinese had their star men who mixed fact and fancy. Star-watching was the business of the old navigators and almanac makers and also, then as now, the field wherein the charlatan astrologers operated. As the needs of navigators and the deep curiosity of the human mind developed in modern times, the great nations began to build observatories. Charles II founded the Greenwich Observatory; Nicholas I, the great Pulkowa Observatory near St. Petersburg; Kaiser Friedrich, the Potsdam Observatory. In America, President John Quincy Adams encouraged the founding of the Harvard Observatory and at an advanced age traveled to Cincinnati to inaugurate the first peoples' institution for the observation of planets and stars.

In recent years astronomical collaboration on the international basis has attracted governmental attention, and the "new orders" in Mexico, Russia, and India include serious attention to astronomy, the most naturally supranational of all human disciplines.

To demonstrate the one-worldness of the stars, the many-nation contributions in the following fields are discussed: (1) measuring the distance to the sun and planets, (2) developing and using the coronagraph, (3) solving the mystery of the corcnal radiation, (4) analyzing the wandering of the earth's North Pole, (5) relativity and the structure of the Universe, (6) the rotation of the Milky Way and of other galaxies, (7) the observation of total solar eclipses. (The full article on which this abstract is based appeared in *Science*, 1948, 108, 315.)

Recording the Bird Life of America With Microphone and Color Camera

A. A. Allen
Cornell University

The Laboratory of Ornithology at Cornell University is assembling a library of natural sounds, especially the songs and calls of birds, mammals, amphibians, and insects. It is believed that these recordings represent scientific facts as much as those that are ordinarily recorded by the eye. With modern methods they can be preserved for study and analyzed with as great accuracy as any other facts of nature. Moreover, the recordings can be of considerable value for educational purposes in training the ears of children to be more discriminating out-of-doors and, incidentally, help adults in identifying the multiplicity of sounds that emanate from the woods and fields and swamps, and indicate what are the animal inhabitants of any area. A special effort has been made to record the voices of birds that are on the verge of extinction, such as the ivory-billed woodpecker, whooping crane, and trumpeter swan.

The Cornell ornithologists are likewise making an effort to record the bird life of America on color film. The National Geographic Society has been assisting this project by financing a series of expeditions to the more interesting ornithological areas in North America and publishing the results in a series of articles by Prof. Allen, illustrated with color plates of the birds. Some of the more recent ones of birds in flight have been made with high-speed (1/5,000 sec) flash apparatus.

In his National Geographic Society lecture in the Ballroom of the Statler Hotel Tuesday evening, Prof. Allen showed representative selections from the color films made in Labrador, Hudson Bay, and Alaska, as well as in many parts of the United States.

On his last expedition to Alaska in June 1948, Prof. Allen's party was successful in finding and filming the nesting habits of the bristle-thighed curlew, the only North American bird whose nest and eggs were unknown to science.

In the name of the Albert R. Brand Bird Song Foundation, the Laboratory of Ornithology at Cornell has published for distribution an album of 72 songs of the common North American birds and one of 27 of the frogs and toads of eastern North America. Another album of bird songs is in preparation. Selections from these recordings accompanied the film.

Technics and the Future of Western Civilization

Lewis Mumford
Amenia, New York

Even many leaders in science and technics no longer believe that the advance of technics automatically ensures the progress of the human race. Doubts have arisen in the most advanced fields, such as nuclear physics. We now realize, as our predecessors a century ago did not, that technics may be lethally misapplied. The chief potential application of atomic energy is at present to mass extermination.

Assuming that Western civilization will survive its present crisis, what internal changes in technics must be made to bring it more directly into the service of life? The three main internal problems of technics are: the problems of time, space, and power; the problem of quantification; and finally, the problem of automatism. The conquest of space and time during the last century has fulfilled the utmost dreams of the early advocates of science and invention; but our achievements here have been steadily frustrated because we have acted as if mechanical invention would automatically solve the problems of human use and application. Unfortunately, at the moment we have achieved the technical means of a universal society, a large part of the world has relapsed into tribalism and isolationism. But modern technics

self is the product of a world-wide culture, in which even e contributions of primitive peoples like the Amazon dians have played an important part. Unless we main- in this world-wide basis, technics itself will go backward.

The problem of quantity is the result of our expansion power. Rejecting the notion of organic norms and hu- an limits, we have brought about a meaningless quantifi- tion of life. In the intellectual realm, to seize an vious example, overproductivity in publication has led an increasing inability to assimilate the output of new terial. To offset "the poverty of overproduction" we ust change the attitudes and purposes of the human gents who operate the machine, reducing production to mounts which the human organism can assimilate and nvert into an orderly, purposive, rational life.

The final achievement of machine production is au- matism; but as the human agent increasingly loses con- ol over the process, he feels insignificant and helpless, ften rebellious. This is not an argument against au- matism itself. We must, however, beware of the ndency of automatism, throughout our society, to bring bout either paralysis of the higher functions or that ndition of lethargic indifference—the vice called acedia the monks of the Middle Ages—which is a product perfected automatic routine. In the older realms of chnics, for one Robert Young who tries to awaken his mnolent colleagues there are 10 anti-Youngs whose otto is "anything for a quiet life."

In short, the whole process of mechanization may be defeated unless we finally engage every part of the hu- an personality. Otherwise, we may bring about a revolt gainst the machine like that Samuel Butler jokingly predicted in *Erewhon*. To overcome the present crisis, oth in technics and in Western civilization, there must e a changeover from mechanical to living criteria. We ust concentrate on the repressed and dwarfed ele- ents in the personality and the community. The final uestion is: "What kind of human being are we trying to roduce?" Not the Power, the Profit Man, or the Me- hanical Man, but the Whole Man must be the central ctor in the new civilization. The 19th-century motto, "Mechanization Takes Command," must be supplemented y the principle of the New Age: Man Takes Command. (The full article on which this abstract is based appeared n *The Saturday Review of Literature* for October 2, 948, under the title "Let Man Take Command.")

Science and the Control of Human Populations

Warren S. Thompson

Scripps Foundation for Research in Population Problems

Since the middle of the 18th Century the population f Occidental lands has undergone a growth in numbers nd a change in distribution which in rate and magnitude re unprecedented. These revolutionary changes in popu- lation growth and distribution are, for the most part, y-products of the accumulation of scientific knowledge nd the application of scientific principles to manipulating and controlling the external environment. Because they have been by-products they have received little attention, and almost no effort has been made to control or guide them in the interest of the group.

This *laissez-faire* population policy is a major departure from the policy of prescientific and nonscientific peoples. Throughout man's history measures of population control have been an integral part of the social and economic regulations by which men lived. In view of the social and economic consequences of science on man's growth, one feels justified in asking: "Has the use of scientific knowledge released man from the necessity of systematically controlling his numbers and their distribution?" Evidence now at hand indicates that although the control of natural processes which science has accomplished has raised the level of comfort for a small fraction of the world's population, it has solved none of the major population problems with which any people is confronted. The problems of population which demand attention today are different from those of our ancestors but are no less urgent than those which troubled them before the era of science.

The peoples of Asia are faced with a Malthusian dilemma. There, any gains in level of living which, judging from our own experience, might have been anticipated from the adoption of machine production, improvement of public health, and advancement of medicine, will probably be consumed very largely in immediate and overwhelming population increase. In the West, on the other hand, the uncontrolled use of contraception threatens to cost the nations which have been the greatest practitioners of science their political and economic dominance.

If one searches for reasons why societies which have made almost a fetish of science have made no effort to use science to develop measures for the control of population as an integral part of their culture, one arrives at the conclusion that at best we are only quasiscientific or semiscientific in our social outlook. The attitude persists that man and his behavior constitute a peculiar class of phenomena which are not subject to scientific investigation. Surely science forces us to conclude that a long-term adaptation to the natural environment which will insure man against eventual extinction can be attained only when this bit of folklore disappears and is replaced with an attitude which encourages the use of scientific methods to secure knowledge with which to effect better and better adaptations of man to his environment and of men to one another.

Wood in an Industrial World

J. A. Hall

U. S. Forest Service, Portland, Oregon

The beginnings of the industrial system in western Europe and the United States were built upon wood. It was with wooden tools and transportation facilities, and iron made with charcoal, that the early implements of the industrial plant were fashioned.

As men learned to use coal for power and the fabrication of steel, wood faded into the background, only to

be replaced by new uses created by the needs of growing industry. Coal is mined by the use of wood for pit props, and coal, iron, and steel must move on steel rails borne on wood. The housing of new industrial centers was of wood, as were the structures of industry until industry itself had become sufficiently stabilized to require permanent structures. Even then, huge quantities of wood were used in the construction phases of steel and concrete buildings.

New industrial populations created demands for food that in turn made necessary the clearing and settling of new agricultural lands. These processes furnished in part the lumber needed to facilitate the new agriculture itself as well as to house the expanding cities. The transportation systems and communication systems that arose of necessity to bind together the complex members of the new system were borne on poles, ties, and piling, all adding to the terrific drain of the new system on the forests of the world.

The industrial system, fed by expanded agriculture, produced the improved implements with which agricultural production expanded to meet the need. Similarly, the greatly increased requirements for wood in the transformed world were met by the fabrication of new machinery for the harvesting, transportation, and fabrication of wood. Thus, the industrial system has produced the equipment with which to process the raw materials of its own being. The modifications to which wood has been subjected by the products of the industrial system itself are many and complex.

In their essence they are characterized by three principal groups:

(1) *Modifications in the physical form of wood.* New machine tools and new methods make possible useful shapes and forms of wood never possible in a handicraft age. The resin glues of chemical industry facilitate the use of veneer and small pieces of wood in the fabrication of precisely engineered structures to meet modern requirements.

(2) *Modification of the physical properties of wood while preserving its fundamental structure.* Wood is preserved against decay and protected against fire by impregnating it with various chemicals. By impregnation with modern synthetic resins and compression in heavy, hydraulic presses of modern design, new types of materials, hard, dense, and strong, are created.

(3) *Use of wood as raw material for chemical industry.* The industrial system made possible the fabrication of large, high-pressure, metal retorts and continuous, high-speed paper machines, and created heavy chemicals in large supply. These elements, reacting on wood, created the pulp and paper industry and the thousands of articles and materials based on wood pulp. New discoveries in the fundamental chemistry of cellulose promise great progress in the fields of synthetic fibers and plastics. Paper and pulp, again in combination with new resin products of chemical industry, compose a bewildering array of new and useful goods.

The expanding population of the world presses hard upon food supply and the limit of food production by traditional agricultural methods has about been reached. Wood, transformed to sugar, can aid greatly in solving the problems thus raised. Wood-sugar solutions can serve in the preparation of fermentation chemicals, the preparation of edible sugars, or as the base for industrial production of protein food.

Thus, the industrial world can feed itself, using the instruments of its own creation and its oldest and newest raw material. (The full article on which this abstract is based appeared in *The Scientific Monthly*, 1948, 67, 398.)

A Theory of the Nerve Impulse

Arturo Rosenblueth
Mexico City

Oxygen Isotopes in Nature and in the Laboratory

Harold C. Urey
University of Chicago

In this paper a review of the uses of isotopes is given, particular mention being made of the applications to tracers, the determination of geological time, and the identification of the remains of living organisms, plant and animal, from the difference in the isotopic abundance of the carbon isotopes. But the one new development which is mentioned in this lecture for the first time is a report of the first determinations of temperatures in which animals lived in past geological ages—in particular, the Upper Cretaceous of Hampshire County, England. These deposits make up the famous chalk cliffs of Dover. Embedded in that chalk are fossils of organisms which lived in ancient times, 60,000,000–70,000,000 years ago. Geological evidence leads geologists to believe that the temperature of this sea was perhaps as warm as the tropical seas of the present time.

This method depends upon the abundance of the O^{18} isotope in calcium carbonate, which is the chemical compound laid down by corals and many shellfish. The amount of O^{18} present in the oxygen of calcium carbonate is different from the amount of O^{18} present in the water in which it is deposited. The difference is rather small. The ratio of O^{18} to O^{16} in nature is about 1: 500, and if this is the abundance in sea water, the abundance in calcium carbonate is about 1.025: 500. This amount depends upon the temperature in which the calcium carbonate is deposited from sea water, the difference amounting to approximately 0.44% between 0° C and 25° C (32° F–77° F). If, therefore, the abundance of the oxygen isotope can be determined with sufficient precision, it is possible to tell at what temperature an animal lived from the isotopic composition of its shell. This is not useful at the present time, since mercury thermometers are far more convenient, but there is the possibility that this will be a very durable thermometer which may have been buried for hundreds of millions of years without being destroyed.

It has been necessary to increase the precision of mass spectrometers used for the measurement of relative

undances of isotopes by approximately a factor of 6 order to measure 1° C. It has also been necessary to epare exceedingly pure samples of carbon dioxide gas order to secure such high precision. The results show at the Upper Cretaceous of England contains, animals own as belemnites, which were similar to the modern uids, which lived between 18° C and 27° C (64° F– ° F). It is not possible to draw too definite conclu- ns in regard to the climatic conditions of these cient seas, for only 6 samples have been investigated in der to estimate the climate over 10,000,000 years, but is work does give us a method for measuring past tem- rature conditions on the surface of the earth. The oblem is not easy and is subject to many errors, just other geological measurements are, but for the first ne a quantitative measurement of this important antity is available.

The problem ahead is very great indeed. To determine e temperature of the earth at the present time by our ual thermometers is a substantial problem. But to termine the temperatures of the earth through a ndred million years or more, using a very complicated cording thermometer, will be difficult. It will be neces- ry to be very discriminating in regard to results se- red. We cannot expect that every fossil has preserved exact record of the temperature at which it lived. We pe to find a limited number of fossils which have reserved this temperature record. (The full article on hich this abstract is based appeared in *Science*, 1948, 08, 489.)

Science, Psychiatry, Survival

Kenneth E. Appel
Institute of the Pennsylvania Hospital Medical School
University of Pennsylvania

Man today is living in an age of revolution. It is a eriod of tension, conflict, instability, and uncertainty. he sources of this are not wholly in the present, but rtly in the training and education people have received, home and school, and in 19th-century science, which phasized matter, mass, motion, energy, force, power, ruggle, and the survival of the fittest.

In industry, man became a *unit* of matter and energy—*thing* to be moved by strength. Philosophy ended in donism and Marxian materialistic dialectic. Economics unciated the doctrine of *laissez faire* and free enter- ise.

Modern technology has produced new conditions of life, onomically, politically, and internationally. It has de- loped big business, monopoly, and urbanization. This s created new conditions in the social relationships of ople: new social classes, unions, aggressive reactions gainst discontents, and strikes.

The effect of 19th-century science has been to stimulate e primitive aggressiveness and fears of men, their needs, pes, fears, ambitions, hostilities, and guilts. What are e going to do with these impulses of hostility and de- ructiveness, increased by recent wars, and economic in- curity, with which our institutions in their present form do not adequately deal? *Increased* mobilization of anxiety and aggressiveness is shown in our society by the increasing burden of mental illness, juvenile delinquency, divorce, alcoholism, social and economic instability.

Many people have been crushed by our materialistic, schizophrenic civilization—schizophrenic, because it has emphasized separateness, exclusion, isolation, instead of relatedness, wholeness, balance, and cooperation. Education has been schizophrenic—split in grooves, unrelated. Education has been chiefly in specialties, with little training for citizenship, grounding in the values of life, the relationships of people, communities, or nations. There is insufficient instruction on the sources of conflict and dissatisfaction in oneself and others, with inadequate cultivation of responsibility to others and to social "causes."

Psychiatry, with its knowledge and means of therapy, offers much that is vitally important for this troubled world. It does not cure people by thinking of them as masses of molecules in motion, but by considering them as personalities with dignity, as people with feelings, needs, desires, and ideals.

Modern psychiatry finds the moving forces in human beings in two alignments—orientation toward self *and* toward social relationships. The child absorbs social attitudes with his mother's milk. Parental attitudes of kindness, warmth, tenderness, tolerance, and patience facilitate an implementation of the social forces. Impatience, undue restrictions, indifference, domination, and rejection plant in the child social attitudes of inferiority, withdrawal, or rebellion. The concept of maturity represents a synthesis of the two forces and provides the only acceptable adjustment for individual satisfaction, social contribution, and acceptance. The essentials of maturity are known today. (These essentials are discussed in the body of this paper.)

Psychotherapy, through contact and experience with another individual (the psychiatrist), affords free expression of the malignant intensifications of fear and hostility and, through discussion and understanding, enables reorganization of the constructive forces of the individual to take place. There are two fundamental elements in psychotherapy: release of the emotions and clarification. Of the two, the feeling reorganization is by far the most important. The "truth-serum" facilitates this release and enables the patient to say just what is on his mind. Think what it would mean if the foreign ministers were given this serum in conference. It would define and clarify issues and situations, and we could all act accordingly.

Parliaments are for society what the psychiatrist's consulting room is for troubled, sick individuals. Troubles can be thrashed out in both places. The United Nations is serving a world function in the same way. We are far better off psychiatrically with it than without it, with all its difficulties. It is far better for Russia to be working off her objections and "Noes" in public than if they were reserved for the diplomatic consulting room. Newspapers perform a great public function in the same way when they present things realistically, without warmongering, vituperation, and misrepresentation. It is whole-

some for Russia to be expressing herself in *Tass* and *Pravda* and for that to be reported in our press.

Institutions are society's hereditary machinery for facilitating social action. They are expressions of forces in men. These forces are for freedom and individuality, control and sociality. Both forces are in all individuals and in all societies. We must not therefore think in terms of either-or. It is not a question of individualism or socialism, *laissez faire* or control, communism or capitalism, totalitarianism or democracy. Both tendencies are in all of us and all nations. Neither tendency can be eliminated by legislation, pious wishes, or denunciation.

The same attitude that the wholesome parent adopts toward the belligerent or nonconforming child, and psychiatry shows to the patient who is suffering from emotional excesses, should be adopted toward nations suffering from nationalistic, adolescent struggles in maturity. All this involves contact. Technology through the airplane and radio has forced intimate *contacts* with strangers and foreigners, with whom we must develop understanding if there are to be satisfactory social relationships. We are applying the institution of frontier, pioneer individualistic nationalism and sovereignty to international relationships, which require different tools. Will these contacts be on primitive, tribal, childish bases of fear and hostility, or will they be channeled through principles of maturity and the attitudes psychiatry has found effective—repeated contact, time, infinite patience, understanding, tolerance for difference, and respect for historic and economic evolution? Destiny is not something wholly visited on us, but is in great part our own creation and responsibility.

The present conflict of nations will not be decided alone by materials of war, but by dealing with our own discontents and devoting our technological genius to the alleviation of our own social and economic conflicts and the creation of a more satisfying, secure, and indestructible way of life. Sources of irrational fear and hate must be recognized. Setting our own house in order and understanding our own and others' irrationalities will add immeasurably to our confidence, power, and security.

Science and UNESCO in World Affairs

Detlev W. Bronk
National Research Council

Medical Research: Operation Humanity

A. C. Ivy
University of Illinois

Modern medicine is one world-wide profession which pursues the same humanitarian aims and uses essentially the same methods everywhere. Amidst havoc and conflict, medicine is now the only scientific agency which knows no distinction as to friend or foe when disease and suffering are at issue. It is generally agreed that the prolongation of life and the alleviation of suffering due to disease has been *the greatest gift of science* to man during the past 100 years.

This achievement has magnified some old and h created some new problems. The problems of degene ative disease and old age and of population and hung have been magnified. The problem of biological wa fare has been created. The unifying principle of th humanitarian spirit of medicine, science, and the hu manities provides a solution of these problems. The co operative efforts of all who have an interest in the spiritu and material welfare of man will be required for th success of this operation for humanity.

Super-High-Energy Accelerators

Leland J. Haworth
Brookhaven National Laboratory

New Worlds for Study

James Hillier
RCA Laboratories, Princeton, New Jersey

The use of short-wavelength electrons and high-quali electron lenses now enables the scientist to surpass th resolving power of the light microscope by a factor more than 100, but the resolution obtained in many spec mens is determined more often by the contrast provide by the specimen than by the resolving power of the in strument. For the wide range of usefulness of the ele tron microscope to be fully appreciated, it must be unde stood that it is not a measuring instrument but a mea of extending man's sense of vision to permit the detail examination of solid materials with structures in th range 0.001–10 μ. Thus, for specimens which are hete geneous to the limit of the instrument, the amount available information has been increased potentially b a factor of 10^6. This is, in effect, a vast and complex ne world in which it will be possible to use our sense vision. Knowledge of this world will come gradually a only after a backlog of experience in it has been acc mulated.

The Human Frontier

Roger J. Williams
The University of Texas

The greatest lack in the world of science today is a adequate knowledge of what people are like—ourselve real human beings. During the next 100 years the phys cal sciences will continue to thrive, but the most significa developments will be in the realm of human scienc Scientists from different disciplines are cooperative studying atomic energy; others cooperatively study th stars; others study the bacteria and viruses. *But the is no place or organization in which the necessary s entists cooperatively study human beings.* This is a j calling for the cooperation of anatomists, physiologis biochemists, and psychologists, as well as social scientis If we leave out of the cooperation the anatomists, phys ologists, and biochemists, we have left out the very o

who can collectively do the most—the ones who are best equipped to use the magnificent tools and methods that natural science has developed. If we leave out individuality in our calculations, we automatically eliminate the possibility of solving some of our most acute problems.

Elementary Particles of Physics

Carl D. Anderson
California Institute of Technology

Researches, past and present, in that important and fundamental field of physics which deals with the properties and relationships of the elementary particles of matter are discussed.

By elementary particles is meant those particles of matter which one finds when any material substance has been broken down into its simplest constituent parts. They have been designated as the "building blocks" out of which all matter, living and inert, is composed.

Up until 1932 scientists had succeeded in identifying two such elementary material particles, the electron and the proton. Then, in rapid succession new elementary particles were discovered: the neutron and positive electron in 1932, the positive and negative mesotrons in 1935, and in 1947 the mesotron was shown to exist in at least two different forms which have widely different properties.

The situation at the present time is characterized by a tremendous boom in activity. New discoveries are announced in the scientific journals almost monthly. Most of the new results are being found in studies of cosmic rays.

The novelty and intricacy of these new phenomena have been so great as to catch the physicist entirely off guard. The actual laboratory findings have proved themselves in their beauty and complexity to surpass even the limits of the physicist's powers of imagination.

He has been forced to give up such ideas as the permanence of the elementary particles, a notion which had previously been basic in his thinking. Elementary particles are continually being created and destroyed. They undergo transformations which spontaneously give rise to other types of elementary particles.

The physicist is unable to state even how many elementary particles of matter there are, let alone to speculate toward an understanding of the implications of these new findings.

How the physical world will look to the physicist after he has succeeded in uncovering enough of those facts so they can be arranged in a logical and understandable theoretical framework no one can say at the present time. All it is possible to say is that he is literally walking into a new and strange world. What the effect on men's lives will be of the exploration and cultivation of this world certainly no one can foretell.

The complete broadcast of "What Hope for Man?" is available from the Town Hall, Inc., New York 18, New York, at 10 cents a copy. Participating in this Town Meeting of the Air on the evening of September 14 in Constitution Hall were Brock Chisholm, director general of the World Health Organization; Fairfield Osborn, president of the New York Zoological Society; Harlow Shapley, director of the Harvard College Observatory; and Edmund W. Sinnott, president of the AAAS and director of the Sheffield Scientific School, Yale University.

A Centennial Volume containing the complete Proceedings of the September 13–17 meeting is planned for publication during 1949 under the editorship of Dr. Sidney S. Negus, president of the Virginia Academy of Science and head of the Department of Chemistry of the Medical College of Virginia. Dr. Negus has also for the past few years been in charge of the Press Room at the annual meetings of the AAAS.

Note: **As arranged earlier, the next meeting of the Association will be held in New York City, December 26 through 31, 1949. There will therefore be *no* meeting of the Association during the remainder of 1948.**

Comments and Communications

Adventures in Mailing *Science*

When a member of the Association receives copies of *Science* through the mails, he often wonders whether it would not be better if they were sent by first-class mail or at least in manila envelopes. If only a few hundred copies were mailed each week, the answer would be obvious. But more than 32,000 copies are mailed to subscribers each Friday. Their total weight is about 6,400 pounds, or 3.2 tons. The cost of sending 6,400 pounds by first-class mail would be more than $3,000, or $156,000 per year.

Fortunately, such publications as *Science* are classified as second-class mail, the postage on which in the first zone is 1.5 cents per pound. In the case of nonprofit organizations, such as the Association, the second-class rate is the same in all postal zones in the United States. The postal rates for foreign countries, except those of the Western Hemisphere, are much higher. The Association has members in 76 foreign countries. The total postage per issue of *Science* is $186, nearly half of which is for copies sent to foreign countries.

The use of manila envelopes for mailing *Science* would add to the mailing costs about $17,000 per year. The total additional cost would be made up of four items: (a) the envelopes, (b) printing on them the postal requirements, (c) the labor of inserting the tons of copies of *Science* in them, and (d) the additional postage because of the weight of the envelopes (about 1,000 pounds per issue of 32,000 copies).

A compromise would be to use manila wrappers. The additional cost would be four items corresponding to those if manila envelopes were used, but somewhat smaller. Nevertheless, the additional cost of mailing would be several thousand dollars per year.

Many letters from members have been received in the past two years, stating that their copies of *Science* were received in bad condition. A large majority of the letters have been courteous descriptions of the conditions in which *Science* had been received from employees of the U. S. Postal Authorities, with the request that the Association undertake to remedy the defects.

The Association has examined all possibilities that do not entail prohibitive expenses. Last January a 70-pound cover was placed on *Science*, with the result that thereafter an average of only about 5 copies out of 32,000 mailed each week are mutilated to such an extent that the recipients complain or ask for duplicate copies. All requests for replacements of mutilated copies are promptly filled.

Occasionally copies of *Science* mailed to a particular post office are entirely missing or badly mutilated. Complaints were received from a university town that the members of one department received very few copies of *Science*. They naturally asked the Association to correct its errors. Upon inquiry it was found that the difficulty was entirely in the local post office, which was reported to lack sufficient help to handle its second-class mail. No complaints have been received since the local post office was informed that *Science* is a scientific journal instead of releases of a promotional nature.

In order to get reliable information about what has been happening to *Science* and why it has been happening, the Association recently made an extensive experiment covering the whole country, including post offices to which many copies of *Science* are mailed and those to which only one or two are mailed. Under the postal regulations, if five or more copies of a publication, such as *Science*, are addressed to one post office, they must be tied in bundles by the printers before delivery to the post office. Since many copies of *Science* are mailed to the larger cities the printers fill entire mail sacks with copies of *Science* alone. It is clear that in such cases the damage to *Science* or the loss of copies occurs in the post office or in delivery or in attempts of mail carriers to place publications in inadequate mail boxes.

Now to return to the experiment! Three copies of the October 15 issue of *Science* were sent to members residing in different parts of the United States, as explained above. One copy was the regular issue sent to more than 32,000 subscribers. The two other copies differed from the regular copy only in the cover stock and paper of the interior. The recipients were notified in advance that they would receive the three copies and were asked to return promptly *all three* of them to the office of the Association in the large manila envelopes which were enclosed, addressed, and stamped for their use. About two-thirds of those chosen for the experiment have returned the copies mailed to them from the printers, and each of them has been sent a regular copy in place of the regular copy returned.

The results of the experiment are, briefly, as follows. The copies having a 70-pound cover were in nearly all cases in excellent, or at least good, condition. About two-thirds of those having 60-pound covers were in good condition; those mailed in 50-pound covers were all in bad or very bad condition. The degree to which copies are mutilated is independent of the distance. The conclusion reached from this experiment is that good 70-pound cover stock should give satisfactory results.

In view of the fact that all three copies to each participant in the experiment were mailed simultaneously, some of the results are difficult to explain. For example, of the three copies sent to Wichita, Kansas, the 70-pound cover was the only one torn appreciably. One of the three copies sent to Ann Arbor, also the one with the 70-pound cover, was not received. The copy with 70-pound cover sent to Dallas, Texas, was not returned. Of the three copies sent to Pittsburgh, the copy having a 70-pound cover was in excellent condition, whereas the covers of the other copies were torn completely off. In contrast, all three copies sent to Pasadena, California, were returned in perfect condition. Three participants in the experiment did not return their copies having the 70-pound cover. Only one copy was reported as having

irty cover, and that was the one with the 70-pound cover the three mailed to Evanston, Illinois.

In spite of the information presented, the question ight still be raised why the Association does not mail journal in wrappers. The estimate of the cost of inting and mailing *Science* in 1949, exclusive of edirial costs, accounting, and addressograph supplies and bor, is $175,000 for an average of 35,000 copies per sue. The present mailing exceeds 32,000 copies per sue.

The average cost for printing and mailing *Science* in 949 will be, according to forecasts, 9.6 cents per copy, $5.00 per year. Only $1.50 of a member's dues of 3.50 remains available for all the other expenses of the ssociation, an amount that would be quite insufficient it were not for advertising in both *Science* and *The ientific Monthly*. *The Scientific Monthly* has a circulaon of nearly 20,000, or more than *Science* had four years go. Since the readers of the two journals do not differ ppreciably in scientific standing or scientific interests d fewer than 1 in 20 subscribe for both journals, *ience* and *The Scientific Monthly* are equally good adrtising media in proportion to their circulations.

F. R. MOULTON

ustralian Sod Fly Introduced Into California (Diptera: Stratiomyidae)

In response to a request for the identification of some culiar flies collected by the writer at San Francisco, lifornia, Dr. Maurice T. James, associate professor of tomology at The State College of Washington and thority on the Stratiomyidae, communicated the follow- g very interesting information which may prove to be considerable economic importance. Dr. James writes: "The fly collected at San Francisco is *Metoponia rubri-ps* Macq., a common species in Australia, where it eeds in sod. I have never before seen it from the New orld. Apparently, the larvae were brought in in soil d have become established in the San Francisco area. he immature forms are well known. For a good deription of them and their biology I can refer you to e following paper, 'Irwin-Smith, Vera. 1920. Proc. nn. Soc. New South Wales.'"

These insects were discovered in San Francisco by the riter on September 21, 1948, crawling about on a lawn rdering Park Presidio Boulevard adjacent to Golden te Park. Only three specimens were taken at that me, two of them being females. Two additional feales were captured a few days later by Dr. Edward Ross, curator of insects in the California Academy of iences. These he found flying low over lawns in Golden te Park. During the same week Mr. Kenneth Innes, student at the University of San Francisco, found a male fouled in wet paint at his home, not far from e Park.

Attempts to find more of the flies failed until the rning of October 7, when the writer discovered them abundance on the campus of the University of San ancisco, several blocks distant from where the first flies had been found. The morning was sunny and sultry. The males were very active, most of them either flying a few inches above the lawn or crowding vantage points on dandelion stems. They were so numerous that a single stroke of the net captured a dozen or more specimens. The females, by contrast, were seen to take wing only occasionally and then only for flights of a few feet. While several sweeps of the net yielded a total of some 100 males, only three females were captured with them. Most of the females merely crawled about on the lawn until they were besieged by the males. A number of mated pairs were observed in the grass. For several days thereafter flies of this same species were found on the same lawn but never in the same abundance. None was observed after October 19.

Irwin-Smith (*loc. cit.*) states that in Australia this species has two broods per year, one appearing in the spring and the other in the autumn. However, she found larvae of varying sizes occurring at all periods of the year and noted that the larval period requires several months, perhaps a year or more. Moreover, she observed the larvae feeding on grass roots and concluded: "It is evident that their main, if not only, source of nourishment is in the juices of the living plant." While these flies appear to do no serious damage to the lawns which they infest in Australia, in America they should be regarded with suspicion as insect immigrants with important economic potentialities. Consequently, they should be watched carefully in this new environment, where they are away from their natural enemies.

EDWARD L. KESSEL

Department of Biology,
University of San Francisco

If This Be Treason—

Never advise a man to go to war or to marry. So runs a proverb at least two centuries old, which I have no intention of transgressing. It may, however, be high time to raise this question: Have not we oldsters gone too far in advocating total abstinence?

For the third time in 30 years I am listening to the arguments against drafting for military service young scientists or young men who have made a gesture toward science. By this time I have heard them all. Never yet have I heard one that did not seem to apply equally to young carpenters, electricians, or plumbers. Worse still, the proponents of these mass exemptions seem to have overlooked what may be very important facts. These young men with an interest in science are human beings. Many of them are also American citizens.

Lately our psychologists have done many interesting things. They have not yet, however, given us even a preliminary report on the present morale and professional efficiency of the men who took their chances in uniform, either by enlistment or draft, as compared with mentally comparable men who sought and secured draft exemption through their importance to any one of a dozen "war essential" projects. Special study might well be given also to the mental condition of the young men who were

held out of uniform against their own wishes. Obviously, once in the war, our chief business is to win. But surely, if a war is really worth winning, some consideration may well be given to the future of the men who win the war or for whom it is won.

There is, too, a wholly different angle that might be studied. That is the question as to whether those active in science are the best judges of the need for their activities and the desirability of the exemption of their potential assistants. Long and intimate association with my scientific colleagues leaves me with the conviction that they measure up well in patriotism with any other group of citizens. That certainly does not mean, however, that they are unprejudiced or that they are good judges of the importance of their own work.

In his farewell address to the Medical School of Harvard University on November 28, 1882, Oliver Wendell Holmes repeated this story:

> When the city was besieged each artisan who was called upon in council to suggest the best means of defence recommended the articles he dealt in: the carpenter, wood; the blacksmith, iron; the mason, brick; until it became a puzzle to know which to adopt. Then the shoemaker said, "Hang your walls with new boots" and gave good reasons why these should be the best of all possible defences.

It could hardly be otherwise. Does it surprise anyone that during war many a man finds in his own specialty great national importance and great need of Federal support? To him it *is* the most important thing that can be done. No doubt it is the most important thing *he* can do. But that is not the question here asked. That question is quite different. Is the contribution these young men may make of such probable value to the Nation that we are justified in compelling or even urging them to separate themselves from the great mass of their fellows and to form a special class? There is another less pleasant possibility. If a mere gesture toward science, mere registration for advanced work in science, means draft exemption, the results may be injurious to science itself. We offer the blatant temptation for men of weak character and morale to select science as safety first. Weak departments will fill their laboratories with weaker students and produce the Ph.D.s who will be the professors of the next generation. All this at a time when science is already too far from humanity for the national good!

In botany at least, the only field with which I can claim familiarity, we need to begin to think of our science not as an end in itself, but as a part of human living. We need more botanists with the courage to say with Kenneth V. Thimann, of Harvard University, "The consequences of major progress in this area are very great, not only to pure science but for agriculture. In these days when so much of the world is near to starvation no worker can fail to carry this thought in the back of his mind, in spite of the frequent statement that research is its own reward and that no further incentive is necessary" (from the Foreword of *Vernalization and photoperiodism:* a symposium, by A. E. Murneek, *et al.* Waltham, Mass.: Chronica Botanica, 1948).

We need to read something other than what is print in our own memoranda and in *Science.* It might not any harm to read even the statements of S. L. A. Marsh one of the editors of the *Detroit News,* who was forme on Gen. Eisenhower's staff in the European Theater Operations, where he directed the Historical Branch the Army. Speaking at Washington and Jefferson C lege on April 16, 1948, he said:

> Sitting at the central seat as I did, in the position uniqu suited to give one the main chance for clear evaluation the forces, material and moral, which made possible our v tory, and determined the balance for defeat or for trium on each of our battlefields, I came through that experie seeing clearly for the first time that the epitome of natio greatness, and the strength which makes for the survival a society, are not to be found in the wealth and producti genius of its industry, or the brilliance of its scient achievement. No indeed! Real national strength and t power to endure and to be made strong again through a versity, do not come of the material triumphs of civilizati but of what the total of surrounding influences puts into t hearts and souls of men.

NEIL E. STEVE
University of Illinois College of Agriculture

Quantitative Estimation of Amino Acids on Paper Chromatograms

The excellent technique for the separation of am acids and other substances by one- and two-dimensio paper chromatography was introduced by Consden, *et* (*Biochem. J.*, 1944, **36**, 224). It has the drawback th as originally described, it is only a qualitative meth or, at most, an approximately quantitative method. S. Keston, *et al.* (*J. Amer. chem. Soc.*, 1947, **69**, 315 A. J. Woiwood (*Nature, Lond.*, 1948, **161**, 169), L. Naf lin (*Nature, Lond.*, 1948, **161**, 763), and others have b able to determine the amino acids or radioactive am acid derivatives separated by paper chromatograp They cut strips or areas from the paper, extracted t amino acid or its derivative, and determined its conc tration in the extract by standard methods. These p cedures suffer from the disadvantage that they eit require specialized equipment or are relatively tedious carry out. R. B. Fisher, D. S. Parsons, and G. A. Mo son (*Nature, Lond.*, 1948, **161**, 764) have described s eral methods based on the observation that the area the paper occupied by the amino acid or other substa is a function of its concentration. This method has b only moderately successful in our hands and could applied only when there was no overlapping of the am acids.

The following procedure has, however, given good sults. The amino acids in a protein hydrolysate divided into three groups: dicarboxylic amino acids adsorption on an anion exchange resin, basic amino ac by adsorption on a "carboxylic" cation exchange re and neutral amino acids. After elution from the re (where necessary) and concentration, 0.01-ml aliq containing less than 0.1 mg of amino acids are chroma graphed. The amino acids are then revealed by spray with ninhydrin or other suitable reagents. The c

ensity of consecutive 5-mm strips is determined with an ectronic transmission densitometer (Photovolt) using e appropriate filter. The color densities are plotted ainst the distance from the starting line, and distribu- on curves are drawn. The areas under the curves give e approximate content of each amino acid. Standard mino acids, both individually and in mixtures, are run de-by-side with the unknown.

In the case of the two-dimensional chromatograms, e area of greatest color density, multiplied by the area the spot, gives the concentration of the amino acid en read from a curve prepared in the same way.

This method has been applied successfully for the antitative estimation of all amino acids in an acid drolysate of proteins except for leucine and isoleucine, hich, as yet, have not been sufficiently separated.

RICHARD J. BLOCK

ew York Medical College,
lower and 5th Avenue Hospitals, New York City

arasites to Aid in the Control of the weet Clover Weevil[1]

The idea of importing parasites to help in the control f injurious insects is by no means new. One of the rly and outstanding achievements along this line was e introduction of the Vedalia beetle from Australia to alifornia by the U. S. Department of Agriculture in 88–89. This became established and has been an im- ortant natural aid in the control of the cottony cushion ale on citrus fruits. Many other examples of success- lly established parasites might be cited. In general, e parasites must be obtained from the land where the estructive species originated, because it is there that ey have had the opportunity to develop.

One of the destructive species about which American griculture has become increasingly concerned is the weet clover weevil, *Sitona cylindricollis.* This species as first recorded on the American continent near Mont- al, Canada, in 1924, having come over from its native urope in some unknown way, and has since spread over uch of the sweet-clover-growing area in the United tates and Canada. It is especially destructive to the weet clover seedlings, often destroying them before they n become established. The damage is largely the result f the feeding on the leaves. This gives the leaves a alloped effect, but, when severe, the plants may be mpletely defoliated. The larvae appear throughout the mmer as small, white, fat grubs in the soil at the base f the plants, where they feed on the rootlets to stunt the ant's growth.

Measures against the weevil have included the application of insecticides and the use of shallow tillage. Of various insecticides a 3% DDT dust applied to the infested fields early in the spring, at the rate of about 20 lbs/acre, has been most effective. Shallow tillage of sweet clover during early summer destroys many of the larvae and pupae at the base of the plants by exposing them to the sun and heat of the surface soil. Delaying the seedling beyond June 15, when weevil activity temporarily subsides, has been observed to give new seedlings a chance to become sufficiently established to survive subsequent weevil damage.

Through the cooperation of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, the North Dakota Agricultural Experiment Station has recently obtained from France two species of insects which are parasitic on the sweet clover weevil. One is a small, hymenopterous species, *Microctonus aethiops,* and the other is a small, dark-colored fly, *Campogaster exigua.* A few small shipments of both species received during the spring and summer of 1948 were released in cages supplied with large numbers of weevils to be parasitized. The cages were constructed of a 36-mesh plastic screen, a type of material which allows the passage of considerably more light than metal screen of similar mesh and probably contributes to more normal conditions for the caged occupants.

The reaction of the weevils to the parasites was interesting. Even though the weevils on this continent had apparently been separated from their parasites since at least 1924 (24 annual generations of the weevil), they immediately indicated fear when exposed to *M. aethiops.* On one occasion *M. aethiops* was observed to stalk a "frantically retreating" weevil for a distance of 30″ in a cage before overtaking it and thrusting an egg into its body. The presence of *C. exigua* in the cages did not cause any observable disturbance of the caged weevils.

H. L. Parker, who supervised the collecting of the parasites, observed that from 20% to 50% of the weevils in the collections were destroyed by *C. exigua* as contrasted with about 4% by *M. aethiops.* If present efforts result in establishing these parasites in this country to the extent that they can shift for themselves, a permanent check on the weevil and an important agency in natural control will have been achieved. The lack of these natural checks on the sweet clover weevil is evidenced by its extensive and rapid spread since its introduction to North America. Where sweet clover formerly thrived the weevil has, in many instances, reduced the acreage of this pasture- and soil-building crop to less than 25% of its former status. To what extent the recently imported parasites are able to become established and effective in checking the weevils awaits to be seen.

J. A. MUNRO and R. L. POST
North Dakota Agricultural Experiment Station, Fargo

[1] Assisting in this investigation are Marvin A. Leraas and enneth S. Engle, students at the North Dakota, Agricul- ral College.

NEWS and Notes

W. E. Martin, formerly professor of zoology at De Pauw University, has been appointed professor and head of the Department of Zoology at the University of Southern California.

Guy J. Goble, of Cornell University, was recently appointed a research assistant professor of entomology at the University of Illinois. He will assist **Gottfried Fraenckel,** formerly of the Imperial Institute of Technology of London, in a new program of research in insect physiology.

Albert B. Sample has resigned as head of the Research Analytical Section of Smith, Kline & French Laboratories, Philadelphia, and is now biochemist with the Laboratory of Clinical Pathology and the John S. Sharpe Research Foundation of the Bryn Mawr Hospital, Bryn Mawr, Pennsylvania.

Norman C. Baenzinger, formerly of the Chemistry Department, Iowa State College, has joined the staff of Mellon Institute's Department of Research in Chemical Physics as a fellow in X-ray diffraction.

Hugh J. McDonald was recently appointed professor of physical chemistry and chairman of the Chemistry Department, Loyola University School of Medicine, Chicago. He was formerly professor of chemistry and director of the Corrosion Research Laboratory at Illinois Institute of Technology.

Earl E. Lackey, Department of Geography, University of Nebraska, will serve as a visiting professor in the Department of Geology and Geography at the University of Tennessee during the forthcoming winter quarter.

Donal Sheehan, formerly director of the Commonwealth Fund, has been appointed chairman of the Scientific Committee of the New York University-Bellevue Medical Center. The full-time post, which will combine with it the duties of professor and chairman of the Department of Anatomy in the College of Medicine, will involve direction of the over-all program of teaching and research at the Center.

Francis Hemming, secretary to the International Commission on Zoological Nomenclature, has announced that his new address is 28 Park Village East, Regent's Park, London, N. W. 1.

The Utah Academy of Sciences, Arts, and Letters has bestowed on Clarence Cottam, assistant director of the Fish and Wildlife Service, an honorary award in recognition of his efforts toward the advancement of science in the field of conservation. This represents only the third such award to be presented to an individual by the Academy.

Liberty Hyde Bailey, of Cornell University, 90-year-old horticulturist and past president of the AAAS, was nominated by the florists of the Nation to be the first recipient of the Women's International Exposition bronze medal for "outstanding contributions to the advancement of horticulture in America." Presentation of the medal to Dr. Bailey early this month in New York City marked the opening of the fourth annual National Flower Week as well as the close of the Exposition.

Fellowships

Northwestern University has received from oil companies two renewed gifts making possible 5 research fellowships in the Department of Chemistry. The Universal Oil Products Company, Chicago, gave $5,000 to continue its support of four predoctoral fellows engaged in catalytic chemistry research in the Ipatieff Laboratory in the Technological Institute. The Texas Company likewise renewed its grant of $1,500 to continue a fellowship in thiophene chemistry.

The first fellowships to be awarded in the field of health physics by the Atomic Energy Commission under its present broad program have gone to 18 student scientists from 12 states. Ten of the fellows are studying at Oak Ridge under the direction of Karl Z. Morgan, director of the Department of Health Physics, and are at the University of Rochester School of Medicine and Dentistry working under Henry A. Blair, director of the AEC Project there. The postgraduate-level courses began November 1.

These fellowships, plus 23 newly awarded predoctoral fellowships in the biological sciences, bring to 247 the total number of students participating in the program during the current academic year.

Colleges and Universities

Ecological field studies were conducted this past summer by a University of Colorado Botanical Expedition to Ungava Bay, in northern Quebec. The expedition, organized and led by John W. Marr, professor of biology, was financed by research grants from the Arctic Institute of North America, the American Philosophical Society, and the National Academy of Sciences. Dr. Marr, assisted by Mrs. Marr, Eric Bonde, and Archie Roach, carried out intensive field work near the Fort Chimo Air Base in Quebec, which is only 30 miles from tree-limit, and along 80 miles of the Leaf River, which parallels tree-limit within a few miles of the northernmost trees. Reconnaissance studies were made along the Koksook River, which cuts across 100 miles of the northern part of the forest-tundra transition region.

Observations and collections were made for ecological studies of tree growth, tundra and forest communities, and pollen analysis. Tree sections, soil samples, quadrat data, and past samples were brought back for intensive study in the laboratory. Small collections of ferns and flowering plants, mammals, and human ecology materials were collected for the University of Colorado Museum.

All chemistry graduates of the City College (New York) are invited to attend the annual dinner of the Chemistry Alumni Association on Monday evening, December 27, at Hotel New Yorker (North Ballroom), 34th Street and 8th Avenue, at 6:30. Reservations ($5.00) may be made through Frank Brescia or Sidney Liebgold, of the Department of Chemistry, City College, Convent Avenue and 139tn Street, New York City 31.

Three new structures for agricultural research are to be built immediately at Iowa State College at a total cost of $77,620. A large swine building, to be erected at the research farm of the Experiment Station, will provide facilities for work on swine nutrition, as will also a swine farrowing house to be built at the veterinary research farm. The third unit will be at the rear of the present genetics laboratory and will be used for studies on the effect of inheritance on resistance to disease in poultry.

A new Department of Engineering Materials at Cornell University represents a consolidation of parallel departments in the Schools of Civil Engineering and Mechanical Engineering. The new department, although now occupying various laboratories in the College, will eventually be housed in the projected Materials and Metallurgy Laboratory. D. F. Gunder, professor of mechanics, has been named acting head.

Meetings and Elections

The Section of Biology, New York Academy of Sciences, is sponsoring a Conference on the Ground Substance of the Mesenchyme and Hyaluronidase on Friday and Saturday, December 3–4, in the Roosevelt Memorial Building of the American Museum of Natural History. The conference chairman will be F. Duran-Reynals, of the Yale School of Medicine. Some 30 papers on various aspects of the subject will be presented during the two-day session by authorities from both U. S. and Canadian institutions.

The Mathematical Association of America, which is holding its 32nd annual meeting at Ohio State University on Friday, December 31, has scheduled the following program: morning session—R. S. Burington, Bureau of Ordnance, Navy Department, "On the Nature of Applied Mathematics"; M. E. Shanks, Purdue University, "Mathematical Aspects of the Theory of Viscous Fluids"; E. T. Welmers, Bell Aircraft Corporation, "Mathematical Aspects of Aero-Elasticity"; afternoon session—annual business meeting; J. R. Britton, Universities of Colorado and Michigan, "Modern Operational Calculus for Undergraduates"; H. W. Brinkmann, Swarthmore College, "Theory of Differential Equations"; E. H. C. Hildebrandt, Northwestern University, "Instructional Aids in the Teaching of Junior College Mathematics."

The Southern Weed Control Conference will be held in connection with the meeting of the Southern Agricultural Workers, January 31–February 2, on the campus of Louisiana State University, Baton Rouge. Those desiring to exhibit weed-killing chemicals and equipment should contact Dr. Clair A. Brown, president of the Conference, who is located at LSU.

CNRS (Centre National de la Recherche Scientifique), which, with the aid of the Rockefeller Foundation, organized a series of international symposia during 1948, has announced that the symposium on Electrophysiology will be held in Paris from March 31 to April 9, 1949, instead of early in December, as originally expected (see *Science*, August 27, p. 203). Another symposium scheduled for Paris around Easter of 1949 will be that on Polarization of Matter, which is being organized by Prof. Pascal.

Summary reports on most of this year's meetings have appeared in the *Revue Scientifique*, and publication of full proceedings is planned for a later date. These include: Physiology and Biochemistry of Lipids, Paris, January; Isotopic Exchange and Molecular Structure, Paris, April; Diffusion of Radiation by Molecules and Crystals (Raman Effect), Bordeaux, April; Methods of Calculation in Mechanics of Fluids, Paris, April; The Chemical Bond, Paris, April; Kinetics and Mechanism of Ignition and Combustion Reactions in the Gas Phase, Paris, April-May; Probability Theory and Mathematical Statistics, Lyons, June-July; Unités Biologiques Douées de Continuité Genetique, Paris, June-July; Vitamins and Antivitamins, Lyons, September-October; and Reactions in the Solid State, Paris, October.

The American Society of Photogrammetry will hold its 15th annual meeting on January 12–14 at the Shoreham Hotel, Washington, D. C. The meeting will demonstrate the latest developments in photogrammetry, surveying, and mapping with exhibits from commercial and governmental establishments and by presentation of papers and discussions on specialized technical subjects. Isaiah Bowman, retiring president of Johns Hopkins University, will present the opening address: "Geographical Objectives in the Polar Regions." Nonmembers of the Society are invited to attend the meeting.

The Fourth Conference on Iroquois Research was held at Red House, New York, October 8–10. The Conference owes its attractive place of meeting, the Administration Building on Red House Lake, to the continued interest of the Hon. Charles E. Congdon, chairman of the Allegany State Park Commission, who, with M. H. Deardorff of Warren, Pennsylvania, issued the invitations and acted as hosts. W. N. Fenton, of the Smithsonian Institution, continued as general chairman of the Conference.

The Conference, attended by anthropologists from the northeastern states and Canada, opened Friday night with an informal address by C. E. Congdon on "The Allegany Country and Its Settlement," which he concluded by reiterating a hope that the Allegany State Park might again become a center of studies. An impromptu contest in singing Indian folk songs from l'Ancienne Lorette was set off by Marius Barbeau and F. G. Speck; and the spirit of whimsey carried over to the report of the Committee on Museum Studies in which Ernest Dodge assessed museum collections awaiting the student of Iroquois material culture and disclosed certain archival sources previously overlooked by ethnohistorians. Discussion pointed to the obvious need of putting a student on the trail of this material, testing his findings in the field, and producing a series of topical reports.

The outstanding accomplishment in Iroquoian studies during 1948, however, was in the field of linguistics, as manifest in the presentation Saturday morning of Comparative Iroquoian by Floyd Lounsbury. Barbeau led the discussion and appraised the sources for the study of Huron-Wyandot.

A seminar led by James Griffin paraded substantial achievement in archaeology on sites scattered from

Maine to Georgian Bay and from the Bay of Quinte south to the Maryland border. Of less interest to archaeologists, perhaps, than Byer's report on his excavations in Maine and those by which Ritchie extended his New York prehistogram to Ontario, but of greater interest to ethnologists, were the reports by Ritchie on large Seneca cemeteries from which Schoff and Wray have taken several hundred human skeletons, Kidd's report on excavating a historic Huron ossuary, and Emerson's account of excavating a Huron longhouse. Carpenter and Witthoft gave parallel reports on New Jersey and Pennsylvania.

The above discussion left but an hour for the seminar on Locality and Kin in Iroquois Culture, which was originally scheduled to set the theme for the Conference. Fenton developed the theme of local differences, drawing materials from comunity studies at Coldspring, Tonawanda, and Six Nations, after which Anthony Wallace, reporting on new field work at Tuscarora, and Augustus F. Brown, on Onondaga, New York, brought new points of view to the field, stressing personality and culture more than structure of society. For the first time it appears likely that the Iroquois, like the Navaho, are becoming a social science laboratory.

The Seneca Indians of Coldspring Longhouse have virtually included the Conference in their yearly round of activities. Led by Albert Jones, a larger number in costume and more besides turned out with enthusiasm for the annual Indian party in honor of F. G. Speck. They afforded abundant materials for illustrating G. Kurath's discussion of structural types of Seneca dances. They proceeded to manage their part in traditional manner, insisting on their own sequence of numbers and choosing their own speakers and interpreter. To our amazement the Johnny Johns performed the dance of the False-faces, and the Hawk Clan gave a name to Dr. George Snyderman.

Discussion turned Sunday morning to the need of a check list of manuscript materials relating to the Iroquois; second, to the applications of research and its techniques to general education; and third, to the need of enlisting a physical anthropologist to work up the expanding series of crania from the area.—W. N. FENTON.

The International Scientific Film Congress organized by the Scientific Film Association of Great Britain with the assistance of the British Film Institute met in London October 4–11. Delegates and observers from 25 countries and UNESCO accepted the invitation to be present. The program of work for the coming year is expected to go far toward establishing the International Scientific Film Association as the central international clearing house of information on all aspects of the scientific film.

Some of the problems to be dealt with by subcommittees are: (1) establishment of an international data card for compiling a master index of scientific films available throughout the world and formulation of methods of appraisal of these films; (2) joint production, by a number of countries, of films of common interest; (3) exchange and distribution on the widest scale of scientific films and the customs regulations affecting such exchange; (4) the setting up of a Scientific Film Reference Library; and (5) exchange of information between nations by means of a regular journal. It is reported that the London Congress made encouraging progress in the preliminary study of these various topics.

Officers elected by members of the Association for the coming year are: Jean Korngold (Poland), president; John Maddison (Great Britain) and C. A. Burmester (Australia), vice-presidents; Jean Painleve (France), honorary secretary; and Luc Haesaerts (Belgium), honorary treasurer.

NRC News

The National Research Council (Prevention of Deterioration Center, Room 204), 2101 Constitution Avenue, N.W., Washington 25, D. C., is offering the "Prevention of Deterioration Abstracts" on a yearly subscription basis. These are classified under the following headings: Biological Agents; Electrical and Electronic Equipment; Fungicides and Other Toxic Compounds; Lacquers, Paints, and Varnishes; Leather; Lubricants; Metals; Miscellaneous; Optical Instruments and Photographic Equipment; Packaging and Storage; Plastics, Resins, Rubbers, and Waxes; Textiles and Cordage; Wood and Paper. Cross references are included in each issue, and author and subject indexes are compiled at the conclusion of each volume. Material for the Abstracts is obtained from journal articles, patents, and unpublished reports from government, university, and industrial research groups both here and abroad.

Approximately 2,000 pages are published a year, in two volumes of 6 issues each. The individual abstracts are in loose-leaf form so that they may be arranged in any manner desired by the individual receiving them. Comments are added to many of the abstracts to correlate relevant information, to evaluate reports, or to make suggestions for further research.

The yearly subscription rate, which includes two sturdy binders and index guides, is currently $37.50. The rate will be $50.00 for requests received after July 1, 1949. All subscriptions run from July 1 to June 30. Back issues are available from April 1946, when the series was started.

An "Advance List," a monthly bibliography of all the reports received in this field by the Prevention of Deterioration Center, is also available for an additional $10.00 per year.

Deaths

Frederick Gardner Cottrell, 71, eminent scientist and inventor, died suddenly of a heart attack while attending the National Academy of Sciences in Berkeley, California, November 16. While an assistant professor of chemistry at the University of California, in 1906–09, Dr. Cottrell perfected the Cottrell electrical precipitator. Later, through his generous altruism, a large part of the funds from sales of the precipitator resulted in the formation of the Research Corporation of New York for stimulation of scientific research (see *Science*, October 15, p. 408.)

Rheinart P. Cowles, 76, professor emeritus of zoology at Johns Hopkins University, died November 16 in Union Memorial Hospital, Baltimore, Maryland. Dr. Cowles had spent his entire teaching period on the Johns Hopkins staff, with the exception of the period from 1912 to 1919, when he headed the Zoology Department, University of the Philippines.

College enrollment figures for this fall, just released by the U. S. Office of Education, reveal that 20 universities enroll 20% of all college students in the United States. This year's total enrollment (2,410,000), the peak in higher education history, represents an increase of 72,000 students over last year, even with a drop of 100,000 in number of veterans enrolled. New York University has the highest enrollment with 47,647, the University of California being a close second with 43,469. The other 18 institutions are: City College of New York (28,567), Columbia University (28,000), Minnesota (27,243), Illinois, (25,920), Ohio State (23,929), Northwestern (23,788), Indiana (23,131), Southern California (22,740), Wisconsin (22,353), Michigan (21,002), Syracuse (19,698), Texas (19,676), Pittsburgh (19,526), Pennsylvania (18,644), Boston (18,617), Wayne (18,455), Temple (17,212), and Washington (16,650).

A list of all National Bureau of Standards publications from 1901 to June 30, 1947, has just become available. Brief abstracts for the publications issued from January 1, 1942, to June 30, 1947, are also included. Circular 460, *Publications of the National Bureau of Standards* (375 pp.), may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at a cost of $.75 a copy.

UNESCO has appointed the Columbia University Press as its official agent in this country for the distribution and sale of its publications. Hitherto, to obtain the books, pamphlets, and documents published by UNESCO, Americans have had to deal directly with the Paris headquarters. Now, through its International Documents Serivce, the Press will not only be able to supply the dozen books and pamphlets and three periodicals already available, but will issue new publications whenever UNESCO has material to offer. The periidicals are *Museum*, an illustrated quarterly art review; *Bulletin for Libraries;* and *UNESCO Courier*, a monthly Journal of news of the organization and its work. Other organizations for which the Press serves as agent are the UN, the FAO, WHO, International Court of Justice, and the Caribbean Commission.

An Army research unit is returning this month to the Federation of Malay States to continue studies on the treatment and prevention of scrub typhus. The American group is sponsored by the Army Medical Department Research and Graduate School, the Commission on Immunization of the Army Epidemiological Board, and the University of Maryland. The group has been invited by the Malayan Government and will again work at the Institute for Medical Research, Kuala Lumpur, in collaboration with scientists of that institution. Members of the group will remain there about four months.

The Economic and Scientific Section, SCAP, announced on November 17 that a scientific mission composed of 5 distinguished American scientists selected by the National Academy of Sciences is scheduled to arrive in Japan this week. The group, which is expected to remain in Japan until the middle of December, includes Detlev W. Bronk, chairman of the National Research Council, foreign secretary of the Academy, and president-elect of Johns Hopkins University; E. C. Stakman, chief of the Division of Plant Pathology and Botany, University of Minnesota, and president-elect of the AAAS; Zay Jeffries, vice-president of the General Electric Company and general manager of its Chemical Department; I. I. Rabi, professor of physics at Columbia University, consultant for the Research and Development Board, and Nobel laureate; and Roger Adams, head of the Department of Chemistry at the University of Illinois and chairman of the Scientific Advisory Group that visited Japan in 1947. Dr. Bronk is chairman of the current mission. The visit of the group coincides approximately with an election of 210 members of the country's first National Science Council—an election in which about 40,000 Japanese scientists will participate. The Americans will review progress made by Japanese scientists in developing Democratic National Organizations for Scientific Activity as well as bring up to date the report submitted by the previous advisory group.

Pathologists preparing for a career in diagnostic laboratory work have an opportunity to receive training in a program now being sponsored by the New York State Department of Health and administered in the Division of Laboratories and Research. Experience in pathology, bacteriology, biochemistry, and other laboratory fields is afforded in this Division and in cooperating institutions in Albany and in New York City. The one-year appointments are open to physicians with postgraduate training in laboratory work who wish additional experience in order to qualify for positions in diagnostic laboratories throughout New York State. The program is approved for one year of training by the American Board of Pathology. Candidates must be U. S. citizens who have graduated from a medical school approved by the American Medical Association. They need not obtain a license to practice medicine in New York State, but they must be eligible to take the examination for license. A stipend is granted to trainees. Inquiries should be directed to the Division of Laboratories and Research, State Department of Health, Albany 1, New York.

Make Plans for—

The National Malaria Society, joint meeting with the **American Society of Tropical Medicine, American Academy of Tropical Medicine,** and **American Society of Parasitologists,** December 5–8, Hotel Roosevelt, New Orleans, Louisiana.

Highway Research Board, 28th annual meeting, December 7–10, National Academy of Sciences, Washington, D. C.

North Central Weed Control Conference, annual meeting, December 8–10, Springfield, Illinois.

Symposium on the Pathogenesis and Pathology of Viral Infections, December 14–15, New York Academy of Medicine, 2 East 103rd Street, New York City.

Society of American Foresters, annual meeting, December 16–18, Statler Hotel, Boston, Massachusetts.

Centennial Greetings to the AAAS From the American Chemical Society

At the various regional meetings of the American Chemical Society, held just prior to the AAAS Centennial Celebration, the following greetings to the Association were read:

One week from today in Washington, D. C., the American Association for the Advancement of Science will open its Centennial Celebration. The American Chemical Society is pleased to extend its heartiest felicitations to the AAAS on the completion of its first 100 years of service.

During the early part of the last century the growing popularity of science led to the formation of several organizations broadly encompassing all branches of the natural and the physical sciences. Among these were the American Philosophical Society and the British Association for the Advancement of Science. The latter body served as the model for its American counterpart, the American Association for the Advancement of Science, which was organized in 1848 from the Association of American Geologists, which had been founded in 1840.

From its second meeting, which was held in Cambridge, Massachusetts, in 1849, chemistry was an important concern of the American Association. One of the sessions of that meeting dealt with "chemistry, mineralogy, and meteorology." From 1850 until 1875, papers presented at the meetings of the Association were given in two technical sessions broadly classified as the physical sciences and natural history. Chemistry was a subsection of the physical sciences. In 1881, nine sections were organized, each with a vice-president, of which chemistry was one. In 1900, the rapid growth in membership was worthy of comment in the proceedings of the AAAS, especially the fact that the growth of the Section on Chemistry had been extraordinary.

This growth of science, particularly in chemistry, in the latter half of the last century resulted in the formation of individual organizations devoted to the special branches of science. Among these was the American Chemical Society, founded in 1876. Its formation as a separate organization dedicated to one of the branches of science served by the American Association has in no way lessened the importance of the American Association in this field. The relations between the two organizations have always been cordial and, in fact, 11 chemists have been presidents of the AAAS. Of these, 8 also have been presidents of the American Chemical Society.

The American Chemical Society has long been an affiliated society of the American Association. In addition, a number of Local Sections of the American Chemical Society have cooperated with the AAAS Section on Chemistry in arranging joint symposia at Association meetings.

The Association is a common meeting ground for all sciences, a factor which is becoming of increasing importance as the boundaries between the sciences grow more diffuse. For example, physicists 10–15 years ago were doing work that now is the field of nuclear chemists. Spectroscopy at its inception was of concern to chemists, who used it for purposes of analysis. Later it became a tool in determining the fundamental laws of atomic structure and, as such, became a field of activity for physicists. In medicine and the biological sciences several branches of science frequently are called into play, and the modern scientific worker in these fields must move easily in each of them. The American Association offers opportunities for interscience contacts of this type.

It is with a feeling of pride that all scientists look back upon the traditions of service built up during the past 100 years by the American Association for the Advancement of Science, and the American Chemical Society is glad to offer its congratulations for the successful century concluded and its hopes for continued success in the future.

Resolution of the AAAS Executive Committee

The following resolution on animal experimentation was passed unanimously by the Executive Committee of the AAAS at its meeting in Washington, D. C., September 15, 1948:

At this Centennial Meeting the American Association for the Advancement of Science reaffirms its conviction that animal experimentation is essential for progress in the biological and medical sciences.

We recognize the important role of animal experimentation in the study of, and the control of, diseases, especially those of childhood, and in the perfecting of those procedures and treatments to which no small part of our community owes its health and life.

We regard with apprehension the activities of certain groups which are attempting to prevent the use of unclaimed animals for study in qualified institutions of biology and medicine.

This Association is in accord with the practically unanimous and often-expressed authoritative voice of science and medicine that animal experimentation has conferred and is conferring inestimable benefits upon mankind, as well as upon animals themselves.

The American Association for the Advancement of Science, with a membership of over 40,000 and representing all the sciences of nature and of man, is confident that a fully informed public will not support legislation which would seriously interfere with the progress of preventive and curative medicine.

The Association believes that a supply of animals for research and teaching purposes for qualified institutions should be assured, by legislation or ordinance where necessary, and not left to the option of local pound officials and private groups.